$3.50 U.S.A. MARCH 1987

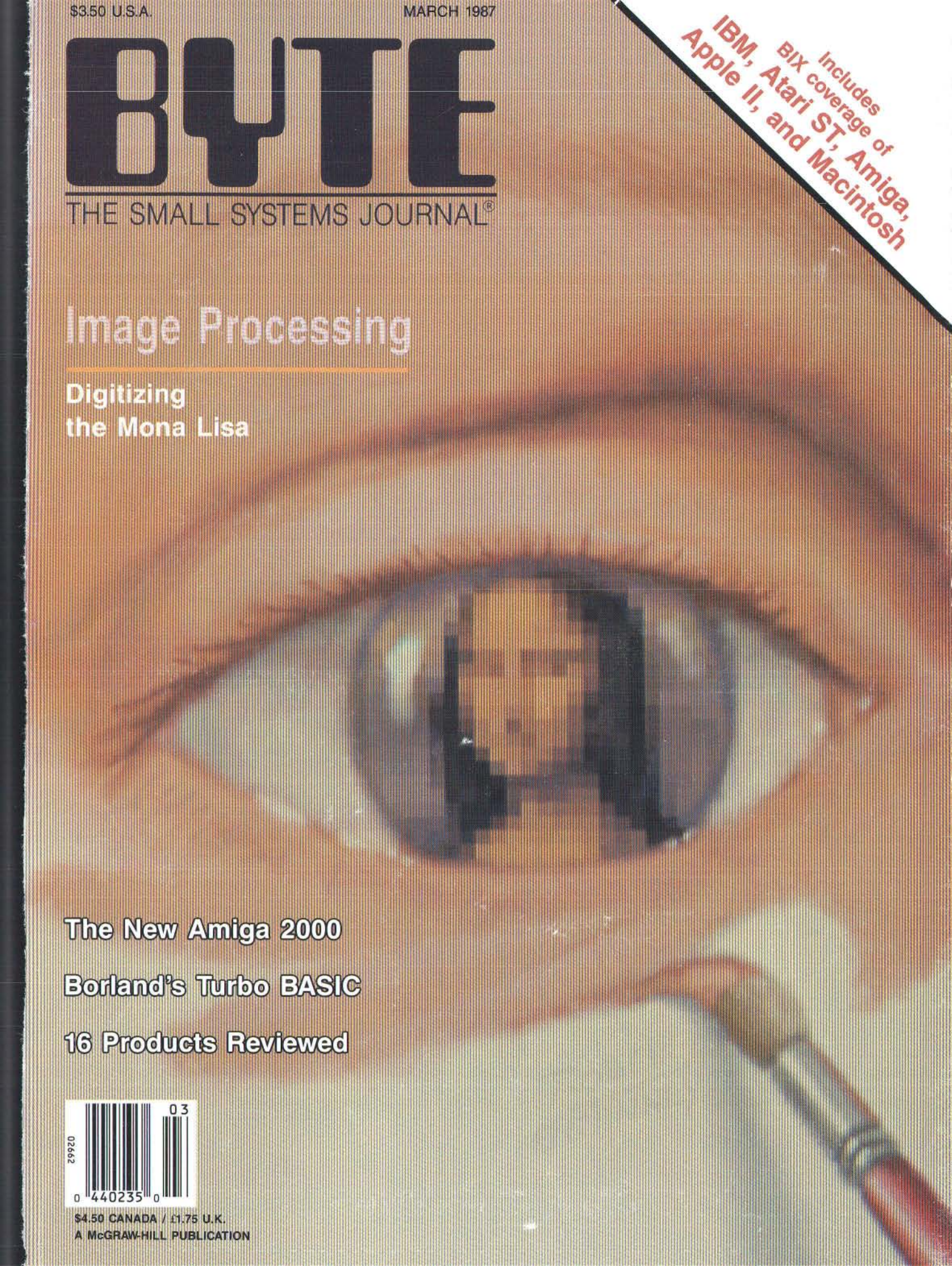
BYTE

THE SMALL SYSTEMS JOURNAL®

Includes BIX coverage of IBM, Atari ST, Amiga, Apple II, and Macintosh

Image Processing

Digitizing the Mona Lisa



The New Amiga 2000

Borland's Turbo BASIC

16 Products Reviewed

02602 03
0 440235 0

$4.50 CANADA / £1.75 U.K.
A McGRAW-HILL PUBLICATION

NEW

Eureka: The Solver™

Anyone and everyone who routinely works with equations needs Eureka: The Solver

It solves the most complex equations in seconds. Whether you're a scientist, engineer, financial analyst, student, teacher, or some other professional, you need Eureka: The Solver!

Any problem that can be expressed as a linear or non-linear equation can be solved with Eureka. Algebra, Trigonometry and Calculus problems are a snap.

Eureka: The Solver also handles maximization and minimization problems, does plot functions, generates reports, and saves you an incredible amount of time.

X+exp(X) = 10 solved instantly instead of eventually!

Imagine you have to "solve for X," where X + exp(X) = 10, and you don't have Eureka: The Solver. What you do have is a problem, because it's going to take a lot of time guessing at "X." Maybe your guesses get closer and closer to the right answer, but it's also getting closer and closer to midnight and you're doing it the hard way.

With Eureka: The Solver, there's no guessing, no dancing in the dark—you get the right answer, right now. (PS: X = 2.0705799, and Eureka solved that one in .4 of a second!)

How to use Eureka: The Solver

It's easy.

1. *Enter your equation into the full-screen editor*
2. *Select the "Solve" command*
3. *Look at the answer*
4. *You're done*

You can then tell Eureka to

- *Evaluate your solution*
- *Plot a graph*
- *Generate a report, then send the output to your printer, disk file or screen*
- *Or all of the above*

Eureka: The Solver includes

- ☑ *A full-screen editor*
- ☑ *Pull-down menus*
- ☑ *Context-sensitive Help*
- ☑ *On-screen calculator*
- ☑ *Automatic 8087 math co-processor chip support*
- ☑ *Powerful financial functions*
- ☑ *Built-in and user-defined math and financial functions*
- ☑ *Ability to generate reports complete with plots and lists*
- ☑ *Polynomial finder*
- ☑ *Inequality solutions*

*Introductory price—good through July 1, 1987

Some of Eureka's key features

You can key in:

- ☑ *A formula or formulas*
- ☑ *A series of equations—and solve for all variables*
- ☑ *Constraints (like X has to be < or = 2)*
- ☑ *A function to plot*
- ☑ *Unit conversions*
- ☑ *Maximization and minimization problems*
- ☑ *Interest Rate/Present Value calculations*
- ☑ *Variables we call "What happens?," like "What happens if I change this variable to 21 and that variable to 27?"*

All this power for only $99.95!

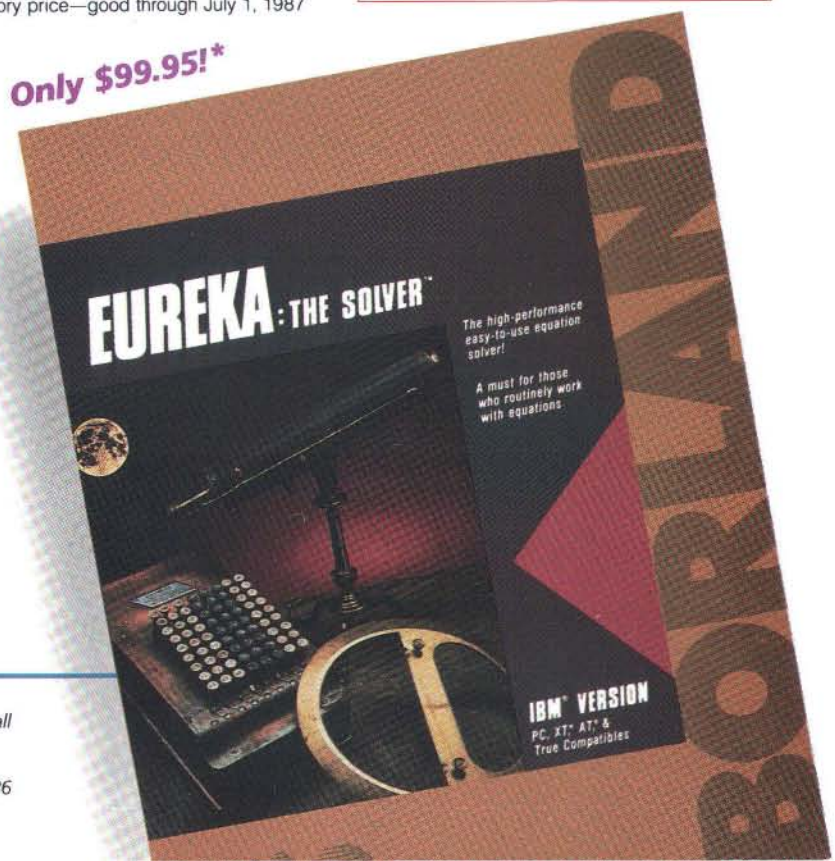
Equation-solving used to be a mainframe problem, but we've solved that problem.

Eureka: The Solver is all you need—and it's yours for only $99.95!

That kind of savings you can calculate with your fingers!

System requirements

IBM PC, AT, XT, Portable, 3270 or true compatibles. PC-DOS (MS-DOS) 2.0 and later. 384K.



BORLAND INTERNATIONAL

Vive la différence

4585 SCOTTS VALLEY DRIVE
SCOTTS VALLEY, CA 95066
(408) 438-8400 TELEX: 172373

GF15

For the dealer nearest you or to order by phone call

(800)255-8008

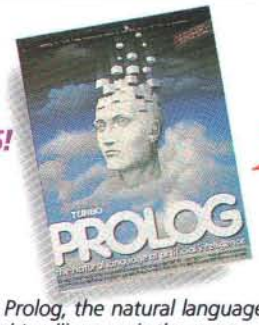
in CA (800) 742-1133 in Canada (800) 237-1136

BI-1103

Turbo Prolog™

> "If you're at all interested in artificial intelligence, databases, expert systems, or new ways of thinking about programming, by all means plunk down your $100 and buy a copy of Turbo Prolog."
> **Bruce Webster, BYTE 9/86**

Only $99.95!



Turbo Prolog, the natural language of Artificial Intelligence, is the most popular AI package in the world with more than 100,000 users. It's the 5th-generation computer programming language that brings supercomputer power to your IBM PC and compatibles. You can join the AI revolution with Turbo Prolog for only $99.95. Step-by-step tutorials, demo programs and source code included.

New! Turbo Prolog Toolbox

NEW

Our new Turbo Prolog Toolbox™ enhances Turbo Prolog—with more than 80 tools and over 8,000 lines of source code that can easily be incorporated into your programs. It includes about 40 example programs that show you how to use and incorporate your new tools.

New Turbo Prolog Toolbox features include:

- ☑ *Business graphic generation*
- ☑ *Complete communications package*
- ☑ *File transfers from Reflex, dBASE III, 1-2-3, Symphony*
- ☑ *A unique parser generator*
- ☑ *Sophisticated user-interface design tools*

System requirements

Turbo Prolog: IBM PC, XT, AT or true compatibles. PC-DOS (MS-DOS) 2.0 or later. 384K. Turbo Prolog Toolbox requires Turbo Prolog 1.10 or higher. Dual-floppy disk drive or hard disk. 512K.

It's the complete developer's toolbox and a major addition to Turbo Prolog. You get a wide variety of menus—pull-down, pop-up, line, tree and box—so you can choose the one that suits your application best. You'll quickly and easily learn how to produce graphics; set up communications with remote devices; read information from Reflex,® dBASE III,® Lotus 1-2-3® and Symphony® files; generate parsers and design user interfaces. All of this for only $99.95.

Only $99.95!



MACINTOSH™ VERSION ALSO AVAILABLE

Turbo Pascal®

The power and high performance of Turbo Pascal is already in the hands of more than half-a-million people. The technically superior Turbo Pascal is the de facto worldwide standard and the clear leader.

The Turbo Pascal family includes:

- *Turbo Pascal® 3.0*
- *Turbo Tutor® 2.0*
- *Turbo Database Toolbox®*
- *Turbo Editor Toolbox®*
- *Turbo Graphix Toolbox®*
- *Turbo GameWorks®*
- *Turbo Pascal Numerical Methods Toolbox™*



Turbo Pascal, the worldwide standard in high-speed compilers, and family.

> "The language deal of the century."
> **Jeff Duntemann, PC Magazine**

New! Turbo Pascal Numerical Methods Toolbox

NEW



Only $99.95!

What our new Numerical Methods Toolbox will do for you now:

- ☑ *Find solutions to equations*
- ☑ *Interpolations*
- ☑ *Calculus: numerical derivatives and integrals*
- ☑ *Differential equations*
- ☑ *Matrix operations: inversions, determinants and eigenvalues*
- ☑ *Least squares approximations*
- ☑ *Fourier transforms*

As well as a free demo FFT program, you also get Least Squares Fit in 5 different forms:

1. *Power*
2. *Exponential*
3. *Logarithm*
4. *5-term Fourier*
5. *5-term Polynomial*

They're all ready to compile and run.

All this for only $99.95!

System requirements

IBM PC, XT, AT or true compatibles. PC-DOS (MS-DOS) 2.0 or later. Turbo Pascal 2.0 or later. Graphics module requires graphics monitor with IBM CGA, IBM EGA, or Hercules compatible adapter card, and requires Turbo Graphix Toolbox. 8087 or 80287 numeric co-processor not required, but recommended for optimal performance. 256K.

Turbo Pascal 3.0.
Includes 8087 & BCD features for 16-bit MS-DOS and CP/M-86 systems. CP/M-80 version minimum memory: 48K; 8087 and BCD features not available. 128K.

NEW

Turbo Basic®

Introducing Turbo Basic, the high-speed BASIC you'd expect from Borland!

It's the BASIC compiler you've been waiting for. And it's so fast that you'll never have to wait again.

Turbo Basic is a complete development environment; it includes a lightning-fast compiler, an interactive editor, and a trace debugging system.

Because Turbo Basic is compatible with BASICA, chances are that you already know how to use Turbo Basic.

With Turbo Basic your only speed is "Full Speed Ahead"!

You probably already know us for both Turbo Pascal® and Turbo Prolog.™ Well, we've done it again!

We created Turbo Basic, because BASIC doesn't have to be slow.

In fact, building fast compilers is a Borland specialty; both our Turbo Pascal and our Turbo Prolog outperform all their rivals by factors, and with Turbo Basic, we're proud to introduce the first high-speed BASIC compiler for the IBM®PC. If BASIC taught you how to walk, Turbo Basic will teach you how to run!

The Critics' Choice

"Borland has succeeded in stretching the language without weighing us down with unnecessary details . . . Turbo Basic is the answer to my wish for a simple yet blindingly fast recreational utility language . . . The one language you can't forget how to use, Turbo Basic is a computer language for the missus, the masters, the masses, and me.

Steve Gibson, InfoWorld

Borland's Turbo Basic has advantages over the Microsoft product, including support of the high-speed 8087 math chip.

John C. Dvorak"

Turbo Basic ends the basic confusion

There's now one standard: Turbo Basic.

It's fast, BASICA-compatible, and because Turbo Basic is a Borland product, the price is right, the quality is there, and the power is at your fingertips. You see, Turbo Basic's part of the fast-growing Borland family of programming languages—we call it the "Turbo Family." Hundreds of thousands of users are already using Borland's languages, so you can't go wrong. So join a whole new generation of smart IBM PC users—get your copy of Turbo Basic today. You get an easy-to-read 300+ page manual, two disks, and a free MicroCalc spreadsheet—and an instant start in the fast new world of Turbo Basic. All of this for only $99.95—Order your copy of Turbo Basic today!

Free spreadsheet included, complete with source code!

Yes, we've included MicroCalc, our sample spreadsheet, complete with source code, so that you can get started right away with a "real program." You can compile and run it "as is," or modify it.

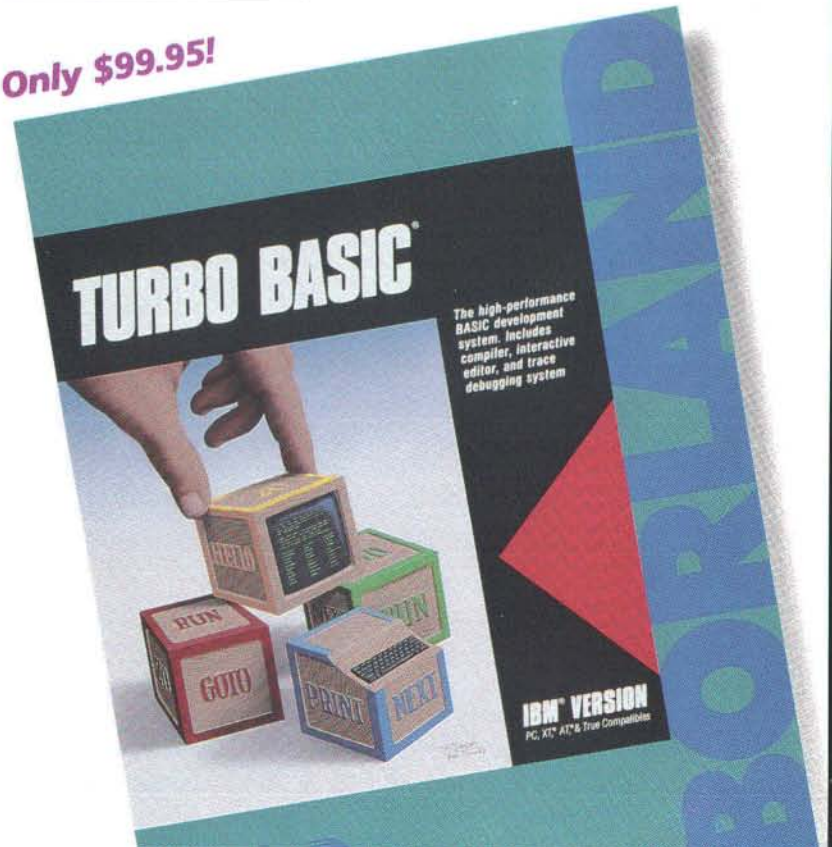
A technical look at Turbo Basic

- ☑ *Full recursion supported*
- ☑ *Standard IEEE floating-point format*
- ☑ *Floating-point support, with full 8087 (math co-processor) integration. Software emulation if no 8087 present*
- ☑ *Program size limited only by available memory (no 64K limitation)*
- ☑ *EGA and CGA support*
- ☑ *Access to local, static, and global variables*
- ☑ *Full integration of the compiler, editor, and executable program, with separate windows for editing, messages, tracing, and execution*
- ☑ *Compile, run-time, and I/O errors place you in the source code where error occurred*
- ☑ *New long integer (32-bit) data type*
- ☑ *Full 80-bit precision*
- ☑ *Pull-down menus*
- ☑ *Full window management*

System requirements

IBM PC, XT, AT and true compatibles, PC-DOS (MS-DOS) 2.0 or later. One floppy drive, 256K.

Only $99.95!



BI-1103

NEW

Turbo C®

Turbo C: The fastest, most efficient and easy-to-use C compiler at any price

Compilation speed is more than 7000 lines a minute, which makes anything less than Turbo C an exercise in slow motion. Expect what only Borland delivers: Quality, Speed, Power and Price.

Turbo C: The C compiler for amateurs and professionals

If you're just beginning and you've "kinda wanted to learn C," now's your chance to do it the easy way. Like Turbo Pascal, Turbo C's got everything to get you going.

If you're already programming in C, switching to Turbo C will considerably increase your productivity and help make your programs both smaller and faster. Actually, writing in Turbo C is a highly productive and effective method—and we speak from experience. Eureka: The Solver and our new generation of software have been developed using Turbo C.

Turbo C: a complete interactive development environment

Free MicroCalc spreadsheet with source code

Like Turbo Pascal and Turbo Prolog, Turbo C comes with an interactive editor that will show you syntax errors right in your source code. Developing, debugging, and running a Turbo C program is a snap.

Turbo C: The C compiler everybody's been waiting for. Everybody but the competition

Borland's "Quality, Speed, Power and Price" commitment isn't idle corporate chatter. The $99.95 price tag on Turbo C isn't a "typo," it's real. So if you'd like to learn C in a hurry, pick up the phone. If you're already using C, switch to Turbo C and see the difference for yourself.

System requirements

IBM PC, XT, AT and true compatibles. PC-DOS (MS-DOS) 2.0 or later. One floppy drive. 320K.

Technical Specifications

- ☑ *Compiler: One-pass compiler generating linkable object modules and inline assembler. Included is Borland's high performance "Turbo Linker." The object module is compatible with the PC-DOS linker. Supports tiny, small, compact, medium, large, and huge memory model libraries. Can mix models with near and far pointers. Includes floating point emulator (utilizes 8087/80287 if installed).*
- ☑ *Interactive Editor: The system includes a powerful, interactive full-screen text editor. If the compiler detects an error, the editor automatically positions the cursor appropriately in the source code.*
- ☑ *Development Environment: A powerful "Make" is included so that managing Turbo C program development is highly efficient. Also includes pull-down menus and windows.*
- ☑ *Links with relocatable object modules created using Borland's Turbo Prolog into a single program.*
- ☑ *ANSI C compatible.*
- ☑ *Start-up routine source code included.*
- ☑ *Both command line and integrated environment versions included.*

*Introductory price—good through July 1, 1987

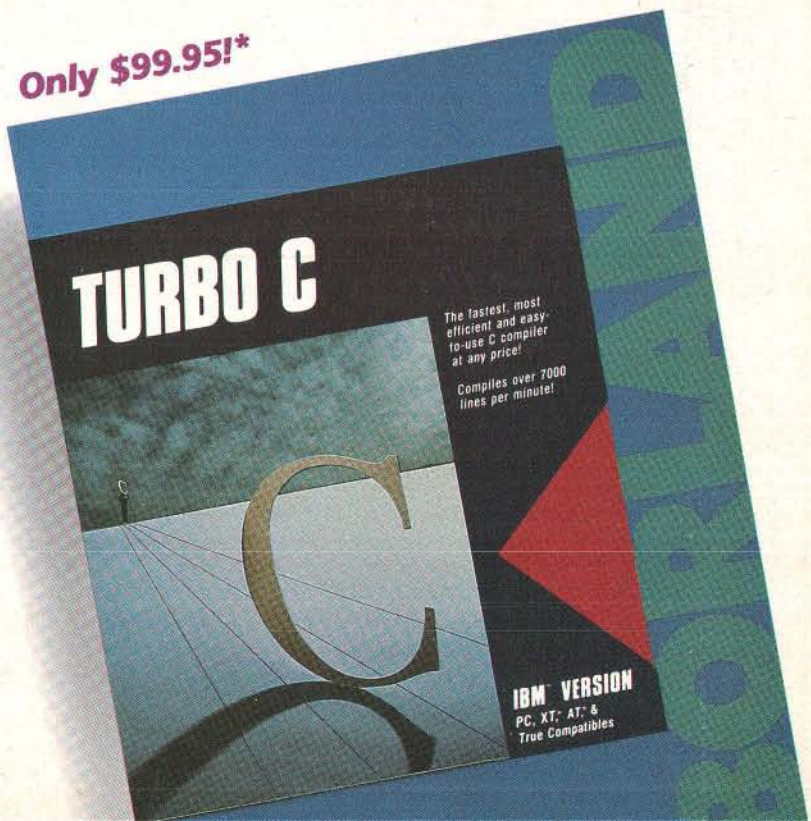
Sieve benchmark (25 iterations)

	Turbo C	Microsoft® C	Lattice C
Compile time	3.89	16.37	13.90
Compile and link time	9.94	29.06	27.79
Execution time	5.77	9.51	13.79
Object code size	274	297	301
Price	$99.95	$450.00	$500.00

Benchmark run on a 6 Mhz IBM AT using Turbo C version 1.0 and the Turbo Linker version 1.0; Microsoft C version 4.0 and the MS overlay linker version 3.51; Lattice C version 3.1 and the MS object linker version 3.05.

All Borland products are trademarks or registered trademarks of Borland International, Inc. or Borland/Analytica, Inc. Other brand and product names are trademarks or registered trademarks of their respective holders. Copyright 1987 Borland International BI-1103

Only $99.95!*



For the dealer nearest you, or to order by phone

call (800) 255-8008

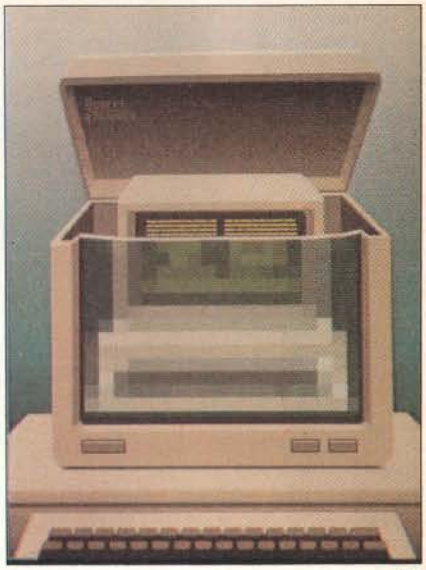
CA (800) 742-1133

Canada (800) 237-1136

Inquiry 41 for End-Users.
Inquiry 42 for DEALERS ONLY.

BYTE

MARCH 1987
VOLUME 12
NUMBER 3



82

Contents

FEATURES

Introduction 82

Product Preview:
The Commodore A2000 84
by Gregg Williams, Tom Thompson, and Richard Grehan
The new Amiga features slots and optional PC compatibility.



A2000

Product Preview:
Turbo BASIC by George A. Stewart 101
Turbo BASIC is Borland International's answer to Microsoft BASIC. It offers 8087 compatibility, fast and versatile compilation, recursion, and it's BASICA-compatible.

Ciarcia's Circuit Cellar:
Build a Trainable Infrared Master Controller 113
by Steve Ciarcia
This device can control all your home entertainment equipment.

Programming Insight:
Building a Random-Number Generator 127
by Brian Wichmann and David Hill
The authors present a Pascal routine for very-long-cycle random-number sequences.

Programming Project:
Installing Memory-Resident Programs with C 129
by Brian Edginton
Use C programs to extend DOS.

THEME: Image Processing

Introduction 140

Probing Space by Camera *by Ken Sheldon* 143
Image processing began as a spin-off from NASA's Jet Propulsion Laboratory.

Digital Image Processing in Art Conservation 151
by John F. Asmus
Digital image processing enables a research team to peer below the surface of the Mona Lisa and trace the painting's evolution.

Introduction to Image Processing Algorithms 169
by Benjamin M. Dawson
The author describes a generic image processing system that you can assemble and use to implement some algorithms.

Low-Cost Image Processing *by Charles McManis* 191
You can build an inexpensive but powerful image processing workstation around the Amiga.

PreScript *by Ken Sheldon* 197
This proposed standard would streamline the process of capturing and manipulating image data.

REVIEWS

Introduction 204

Reviewer's Notebook *by Cathryn Baskin* 207

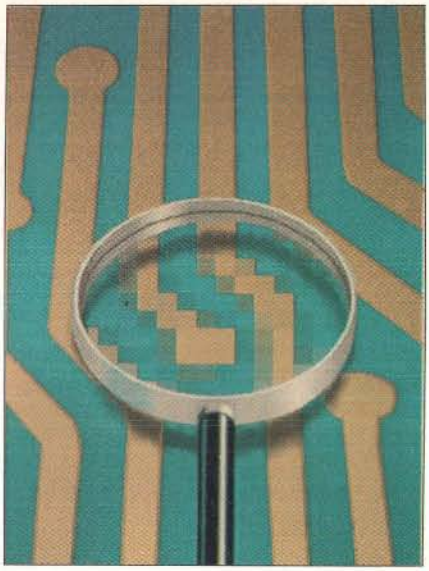
A Trio of 8-MHz PC AT Compatibles 209
by Stan Miastkowski
Three machines that vary in options, software, and price.

AT&T's TrueVision Image Processing System 215
by Robert Tinney
This system lets you capture, digitize, and manipulate real-time images.

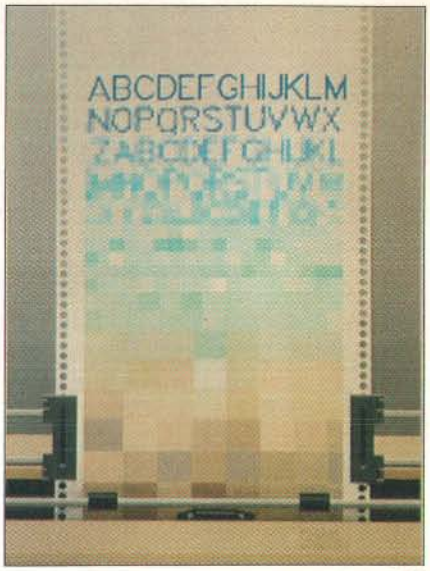
COVER PAINTING BY ROBERT TINNEY



140



204



248

Four Laser Printers *by Arthur Little* 217
Offerings from Canon, BDS, Quadram, and QMS.

PC Scheme: A Lexical LISP *by William G. Wong* ... 223
An implementation of Scheme for IBM PC compatibiles.

Concurrent PC DOS *by Wayne Rash Jr.* 226
Support for multiple programs and external terminals.

Wendin's Operating System Toolbox 228
by Jason Levitt
Help for creating your own operating system.

PFS: First Choice *by Larry D. Allen* 235
Word processing, a spreadsheet, telecommunications, and file management.

WriteNow for the Macintosh *by Mick O'Neil* 237
A word processor that picks up where MacWrite left off.

CAD-3D *by Rusel DeMaria* 238
Three-dimensional modeling for the Atari ST.

Review Feedback 244
Readers respond to previous reviews.

KERNEL

Introduction 248

Computing at Chaos Manor: The Curse of Chaos Manor *by Jerry Pournelle* 251
A lack of working computers gave Jerry an especially chaotic month.

Applications Only: Status Report *by Ezra Shapiro* ... 271
Ezra reveals his biases by mentioning which products he uses regularly.

BYTE U.K.: Taking Control *by Dick Pountain* 279
Dick plays with three systems that let a microcomputer control events in the real world.

According to Webster: Amiga Developers Conference 291
by Bruce Webster
New products and books for the Amiga are appearing.

BEST OF BIX

Amiga 311
Atari ST 316
IBM PC and Compatibles 324
Apple II/Macintosh ... 330
BASIC 340
Pascal 344

DEPARTMENTS

Editorial: The Enigma of the Amiga 2000 6
Microbytes 9
Letters 16
What's New 29
Events and Clubs 49
Ask BYTE 52
Circuit Cellar Feedback 58
Book Reviews 67
Chaos Manor Mail 301
BOMB and Coming Up in BYTE 400
Editorial Index by Company 401
Reader Service 403

LISTINGS

From BIX 354
From BYTEnet ..... (617) 861-9764
On Disk ..... see card after 352
In Print ..... see card after 352

BYTE (ISSN 0360-5280) is published monthly with one extra issue per year by McGraw-Hill Inc. Founder: James H. McGraw (1860-1948). Executive, editorial, circulation, and advertising offices: One Phoenix Mill Lane, Peterborough, NH 03458, phone (603) 924-9281. Office hours: Monday through Thursday 8:30 AM — 4:30 PM, Friday 8:30 AM — 1:00 PM, Eastern Time. Address subscriptions to BYTE Subscriptions, P.O. Box 590, Martinsville, NJ 08836. Postmaster: send address changes, USPS Form 3579, undeliverable copies, and fulfillment questions to BYTE Subscriptions, P.O. Box 596, Martinsville, NJ 08836. Second-class postage paid at Peterborough, NH 03458 and additional mailing offices. Postage paid at Winnipeg, Manitoba. Registration number 9321. Subscriptions are $22 for one year, $40 for two years, and $58 for three years in the U.S. and its possessions. In Canada and Mexico, $25 for one year, $45 for two years, $65 for three years. $69 for one year air delivery to Europe. 31,000 yen for one year air delivery to Japan. 15,600 yen for one year surface delivery to Japan. $37 surface delivery elsewhere. Air delivery to selected areas at additional rates upon request. Single copy price is $3.50 in the U.S. and its possessions, $4.25 in Canada and Mexico, $4.50 in Europe, and $5 elsewhere. Foreign subscriptions and sales should be remitted in U.S. funds drawn on a U.S. bank. Please allow six to eight weeks for delivery of first issue. Printed in the United States of America.

Address editorial correspondence to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Unacceptable manuscripts will be returned if accompanied by sufficient postage. Not responsible for lost manuscripts or photos. Opinions expressed by the authors are not necessarily those of BYTE.

Copyright © 1987 by McGraw-Hill Inc. All rights reserved. Trademark registered in the United States Patent and Trademark Office. Where necessary, permission is granted by the copyright owner for libraries and others registered with the Copyright Clearance Center (CCC) to photocopy any article herein for the flat fee of $1.50 per copy of the article or any part thereof. Correspondence and payment should be sent directly to the CCC, 29 Congress St., Salem, MA 01970. Specify ISSN 0360-5280/83, $1.50. Copying done for other than personal or internal reference use without the permission of McGraw-Hill Inc. is prohibited. Requests for special permission or bulk orders should be addressed to the publisher. BYTE is available in microform from University Microfilms International, 300 North Zeeb Rd., Dept. PR, Ann Arbor, MI 48106 or 18 Bedford Row, Dept. PR, London WC1R 4EJ, England.

Subscription questions or problems should be addressed to: BYTE Subscriber Service, P.O. Box 328, Hancock, NH 03449

SECTION ART BY ROBERT TINNEY

BYTE

SENIOR VICE PRESIDENT/PUBLISHER
Harry L. Brown
EDITOR IN CHIEF
Philip Lemmons

BIX

MANAGING EDITOR, BYTE
Frederic S. Langa

EXECUTIVE EDITOR, BIX
George Bond

ASSISTANT MANAGING EDITOR
Glenn Hartwig
CONSULTING EDITORS
Steve Ciarcia
Jerry Pournelle
Ezra Shapiro
Bruce Webster
SENIOR TECHNICAL EDITORS
Cathryn Baskin, Reviews
G. Michael Vose, Themes
Gregg Williams, Features
TECHNICAL EDITORS
Dennis Allen
Richard Grehan
Ken Sheldon
George A. Stewart
Jane Morrill Tazelaar
Tom Thompson
Charles D. Weston
Eva White
Stanley Wszola
ASSOCIATE TECHNICAL EDITORS
Curtis Franklin Jr., Best of BIX
Margaret Cook Gurney, Book Reviews
Brenda McLaughlin, Applications Software Reviews, San Francisco

COPY EDITORS
Bud Sadler, Chief
Jeff Edmonds
Nancy Hayes
Cathy Kingery
Lauren Stickler
Warren Williamson
Judy Winkler

ASSISTANTS
Peggy Dunham, Office Manager
Martha Hicks
L. Ryan McCombs
June N. Sheldon

NEWS AND TECHNOLOGY
Gene Smarte, Bureau Chief, Costa Mesa
Jonathan Erickson, Senior Technical Editor, San Francisco
Rich Malloy, Senior Technical Editor, New York
Cindy Kiddoo, Editorial Assistant, San Francisco
ASSOCIATE NEWS EDITORS
Dennis Barker, Microbytes
Anne Fischer Lent, What's New
Stan Miastkowski, What's New

CONTRIBUTING EDITORS
Jonathan Amsterdam, programming projects
Mark Dahmke, video, operating systems
Mark Haas, at large
Rik Jadrnicek, CAD, graphics, spreadsheets
Robert T. Kurosaka, mathematical recreations
Alastair J. W. Mayer, software
Alan R. Miller, languages and engineering
Dick Pountain, U.K.
Roger Powell, computers and music
Phillip Robinson, semiconductors
Jon Shiell, high-performance systems

ART
Nancy Rice, Art Director
Joseph A. Gallagher, Assistant Art Director
Jan Muller, Art Assistant
Alan Easton, Drafting

PRODUCTION
David R. Anderson, Production Director
Denise Chartrand
Michael J. Lonsky
Virginia Reardon

TYPOGRAPHY
Sherry McCarthy, Chief Typographer
Selinda Chiquoine
Donna Sweeney

SENIOR EDITOR
David Betz
ASSOCIATE EDITORS
Tony Lockwood
Donna Osgood, San Francisco
MICROBYTES DAILY
Dennis Barker, Coordinator, Peterborough
Gene Smarte, Bureau Chief, Costa Mesa
Rick Cook, Phoenix
Jonathan Erickson, San Francisco
Martha Hicks, Peterborough
Cindy Kiddoo, San Francisco
Anne Fischer Lent, Peterborough
Rich Malloy, New York
Stan Miastkowski, Peterborough
Lynne Nadeau, Peterborough
David Needle, San Francisco
Wayne Rash, Washington, DC
Lamont Wood, San Antonio
GROUP MODERATORS
David Allen, Applications
Frank Boosman, Artificial Intelligence
Leroy Casterline, Other
Marc Greenfield, Programming Languages
Jim Howard, Graphics
Gary Kendall, Operating Systems
Steve Krenek, Computers
Brock Meeks, Telecommunications
Barry Nance, New Technology
Donald Osgood, Computers
Sue Rosenberg, Other
Jon Swanson, Chips
BUSINESS AND MARKETING
Doug Webster, Director (603-924-9027)
Patricia Bausum, Secretary
Denise A. Greene, Customer Service
Brian Warnock, Customer Service
Tammy Burgess, Customer Credit and Billing
TECHNOLOGY
Clayton Lisle, Director, Business Systems Technology, MHIS
Bill Garrison, Business Systems Analyst
Jack Reilly, Business Systems Analyst

ADVERTISING SALES
Dennis J. Riley, Director of Sales and Marketing
Sandra Foster, Administrative Assistant
ADVERTISING/PRODUCTION (603-924-6448)
Lisa Wozmak, Supervisor
Lyda Clark, Senior Account Coordinator
Marion Carlson
Virginia Carpenter
Karen Cilley
Brian Higgins
Wai Chiu Li, Quality Control Manager
Julie Murphree, Advertising/Production Coordinator
MARKETING COMMUNICATIONS
Horace T. Howland, Director (603-924-3424)
Vicki Reynolds, Promotion Manager
Lisa Jo Steiner, Marketing Assistant
Stephanie Warnesky, Marketing Art Director
Sharon Price, Associate Art Director
Julie Perron, Market Research Analyst
Cynthia Damato Sands, Reader Service Coordinator

TELEMARKETING
L. Bradley Browne, Director
Susan Boyd, Administrative Assistant

PLANNING AND RESEARCH
Michele Perron, Director
Faith Kluntz, Copyrights Coordinator

FINANCIAL SERVICES
Philip L. Penny, Director of Finance and Services
Kenneth A. King, Business Director
Christine Lee, Assistant
Vicki Weston, Accounting Manager
Linda Short, D/P Manager
Marilyn Haigh
Diane Henry
Vern Rockwell
Lisa Teates
JoAnn Walter

PUBLISHER'S ASSISTANT
Beverly Jackson

CIRCULATION (800-423-8912)
Dan McLaughlin, Director
Jennifer Price
James Bingham, Single-Copy Sales Manager
Claudette Carswell, Distribution Coordinator
Karen Desroches
Louise Menegus

PERSONNEL
Cheryl Hurd, Office Manager
Patricia Burke, Personnel Coordinator

BUILDING SERVICES/TRAFFIC
Anthony Bennett, Building Services Manager
Mark Monkton, Assistant
Agnes E. Perry, Traffic Assistant

RECEPTIONIST
Donna Healy

Officers of McGraw-Hill Information Systems Company: President: Richard B. Miller. Executive Vice Presidents: Frederick P. Jannott, Construction Information Group; Russell C. White, Computers and Communications Information Group; J. Thomas Ryan, Marketing and International. Senior Vice Presidents-Publishers: Laurence Altman, Electronics; Harry L. Brown, BYTE; David J. McGrath, Engineering News-Record. Group Vice Presidents: Frank A. Shinal, Dodge; Peter B. McCuen, Communications Information. Vice Presidents: Robert D. Daleo, Controller; Fred O. Jensen, Planning and Development; Michael J. Koeller, Human Resources; Talat M. Sadiq, Systems Planning and Technology.

Officers of McGraw-Hill, Inc.: Harold W. McGraw, Jr., Chairman; Joseph L. Dionne, President and Chief Executive Officer; Robert N. Landes, Executive Vice President and Secretary; Walter D. Serwatka, Executive Vice President and Chief Financial Officer; Shel F. Asen, Senior Vice President, Manufacturing; Robert J. Bahash, Senior Vice President, Finance and Manufacturing; Ralph R. Schulz, Senior Vice President, Editorial; George R. Elsinger, Vice President, Circulation; Ralph J. Webb, Vice President and Treasurer.

BYTE, BYTE, and The Small Systems Journal are registered trademarks of McGraw-Hill Inc.

EDITORIAL AND BUSINESS OFFICE:
One Phoenix Mill Lane, Peterborough, New Hampshire 03458, (603) 924-9281.

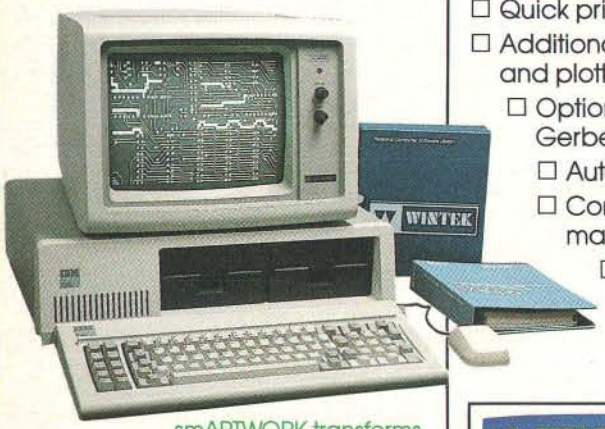
West Coast Offices: 425 Battery St., San Francisco, CA 94111, (415) 954-9718; 3001 Red Hill Ave., Building #1, Suite 222, Costa Mesa, CA 92626, (714) 557-6292. **New York Editorial Office:** 1221 Avenue of the Americas, New York, NY 10020, (212) 512-3175.

BYTEnet: (617) 861-9764 (set modem at 8-1-N or 7-1-E; 300 or 1200 baud).

smARTWORK® Keeps Getting Smarter

Smarter Artwork

Three years ago, Wintek engineers created smARTWORK to reduce the time and tedium of laying out their own printed-circuit boards. Thousands of engineers have since discovered the ease of use and sophistication that makes smARTWORK the most popular PCB CAD software available. And thanks to them, smARTWORK keeps getting better.



smARTWORK transforms your IBM PC into a PCB CAD system

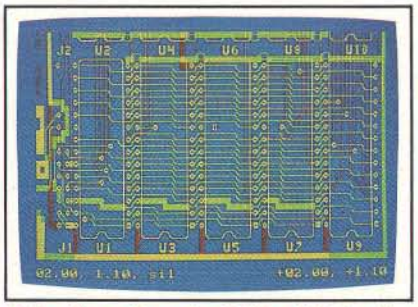
Interactive routing, continual design-rule checking, pad shaving, and production-quality 2X artwork have always been a part of smARTWORK. And now that many customer suggestions have become a part of the software, smARTWORK is an even better value. *That's why we offer it with a thirty-day money-back no-nonsense guarantee.*



Using an Epson or IBM dot-matrix printer, you can create 2X artwork and 1X or 2X checkplots in a fraction of the time hand-taping requires

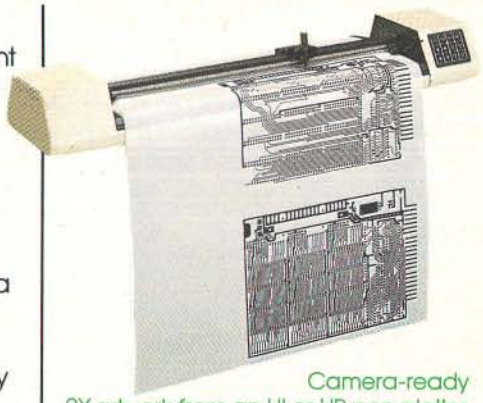
New smARTWORK Features

- ☐ Silkscreen layer for component placement and identification
- ☐ Text capabilities for all three layers
- ☐ Selectable trace widths and pad shapes and sizes
- ☐ User-definable library
- ☐ Ground planes created with a single command
- ☐ Solder-mask and padmaster plots generated automatically
- ☐ Quick printer 2X checkplots
- ☐ Additional drivers for printers and plotters
- ☐ Optional drill-tape and Gerber photoplotter utilities
- ☐ AutoCAD® .DXF file output
- ☐ Completely updated manual
- ☐ 800 number for free technical assistance



2" by 4" section of a 10" by 16" double-sided board with silkscreen layer

Current Versions	
HiWIRE	V1.0r0
smARTWORK	V1.2r6



Camera-ready 2X artwork from an HI or HP pen plotter

The Smart Buy. Guaranteed.

Still priced at $895, smARTWORK is proven, convenient, and fast. Our money-back guarantee lets you try smARTWORK for 30 days at absolutely no risk. Call toll free (800) 742-6809 today and put smARTWORK to work for you tomorrow. That's smart work.

System Requirements

- ☐ IBM PC, PC XT, or PC AT with 384K RAM, and DOS V2.0 or later
- ☐ IBM Color/Graphics Adapter with RGB color or B&W monitor
- ☐ IBM Graphics Printer or Epson FX/MX/RX-series printer, and/or
- ☐ Houston Instrument DMP-40, 41, 42, 51, 52, or Hewlett-Packard 7470, 7475, 7550, 7580, 7585, 7586 pen plotter
- ☐ Optional Microsoft Mouse

Wintek Corporation
1801 South St.
Lafayette, IN 47904
Telephone: (800) 742-6809
In Indiana: (317) 742-8428
Telex: 70-9079 WINTEK CORP UD

WINTEK®

"smARTWORK", "Wintek", and the Wintek logo are registered trademarks of Wintek Corporation. "AutoCAD" is a registered trademark of Autodesk, Inc.

Europe: RIVA Terminals Ltd., England, Phone: 04862-71001, Telex: 859502 / Australia: Entertainment Audio Pty. Ltd., Phone: (08) 363-0454 or (008) 88 8414 / Brazil: Comicro Informatica E Tecnologia Ltda., Phone: (041) 224-5616

EDITORIAL

The Enigma of the Amiga 2000

What is a 4.77-megahertz 8088 doing inside a 7-MHz 68000 system like the Commodore A2000 (aka Amiga 2000), covered this month in our lead feature article? Running IBM PC software, of course. The Amiga 2000 is the first of several new personal computers that offer IBM compatibility as one of several features. The Amiga 2000 has a lot going for it: the open architecture, with seven internal expansion slots; the Janus card, an IBM PC XT clone that shares dual-port RAM with the 68000; and the ability to use several slots for IBM-compatible cards, like card-mounted hard disks and disk controllers, and thereby to open up the entire world of IBM-compatible peripheral devices to the Amiga.

Besides the seven main expansion slots, the Amiga 2000 has two special slots: one for a CPU and another for a video controller. Try as we might, we were unable to pry out of Commodore any significant information about plans for those two slots. If the CPU slot should receive a 68020 with memory management unit and floating-point chip soon, the Amiga 2000 may emerge as a powerhouse. Commodore already has projects involving the 68020 under way in its labs but says nothing about what will emerge or when. If the video slot should receive a card that provides 640 by 400 noninterlaced video, one of the strongest objections to the Amiga would be overcome.

After much discussion, we decided against making the Amiga 2000 a cover story. With both the CPU slot and the special video slot unused, the Amiga 2000 is a very much enhanced Amiga 1000 rather than the foundation of a new series of machines. The Amiga 2000 does open up the Amiga 1000 more than the Macintosh Plus opened up the Macintosh. But as with the Mac Plus, the Amiga 2000 has the same processor running at the same clock speed with the same display controller as the previous machine in the series.

We have not yet had access to Atari's new Mega STs, its $499 IBM PC compatible with built-in EGA compatibility, or its $1500 laser printer. We will cover these products as soon as we get our hands on them. We also await the new Commodore IBM PC compatibles introduced at the Consumer Electronics Show.



New BIX Hardware

BIX, the BYTE Information Exchange, now has more than 12,000 users, the estimated capacity for the 1986 Arete supermicrocomputer running BIX. The system continues to perform well despite the heavy work load, but it is clear that the hardware must be expanded dramatically to support the substantial growth planned for 1987 and beyond. Indeed, we stopped promotional mailings for several months in order to avoid swamping the current 88-port BIX system. We will replace the system with a new one capable of supporting 250 simultaneous users, with NFS (network file server) networking capability to provide for expansion to even greater size. Approximately 20 companies were invited to submit proposals for the next generation of BIX hardware, and most did so. Bidders were required to submit hardware configurations permitting growth to 500 and then 1000 simultaneous users.

As of this writing, the number of bidders has been narrowed to four by our technical team at McGraw-Hill in New York. Two supermicrocomputer companies and two superminicomputer companies remain in contention. We are installing BIX software on all the remaining contenders and running simulations of various user loads.

By the time you read this, we should have selected a vendor and be in the process of installing the new system. If we should encounter performance problems before the new system is up, rest assured that hardware capacity will soon triple.

New Staff for Microbytes Daily

We are pleased to announce that management has authorized expansion of the staff of the Microbytes Daily news service that operates on BIX. These staff additions will enable us to provide comprehensive product coverage in the microbytes.hw and microbytes.sw sections, as well as to expand our coverage of technology news and preannouncement product news in the general microbytes/items section and timely feature articles in the microbytes/features section.

The entire news service is available at standard BIX rates—vastly less than the rates charged by other on-line news services. Furthermore, the Microbytes Daily news service is interactive. If you want coverage of a specific topic and can't find it by using the "search" command, please send BIX electronic mail to "microbytes" and let us know. We'll do our best to dig out the information you need. Before major computer shows, we post the list of scheduled exhibitors and ask BIX users to tell us which exhibits they are most interested in. We then visit those exhibits at the show. All in all, Microbytes Daily is well worth consulting before you make any purchasing decision about computer products.

80386 Events

If your interests lie in 80386-based systems, you shouldn't miss the rich related events on BIX. The os386 conference has fascinating in-depth discussions of systems software issues. Users386 has an exchange of user opinions and reactions to the early 80386 machines. Finally, BIX's Compaq conference has a lively topic on the Compaq 386. We'll publish some highlights in BYTE, but we don't have room for nearly enough of the valuable information found in these three conferences.

—Phil Lemmons
Editor in Chief



When computers get down to business, they move up to Maxell.



Maxell is ready when you are with the newest technology in magnetic media. A perfect example is this double-sided 3½″ microdisk.

maxell
THE GOLD STANDARD

Maxell Corporation of America, 60 Oxford Drive, Moonachie, NJ 07074

smarterm®

The Next Evolutionary Step in Communications Software

In the world of communications, the result of natural selection isn't always "terminal".

You can access your mini computer using standard terminals. But the smarter alternative is an IBM* compatible PC and SmarTerm terminal emulation software—an advanced species of communications software.

Persoft began where most terminal emulation software companies strive to end—with exact, feature-for-feature emulation. Then Persoft took SmarTerm software to the next stage of evolution: superiority.

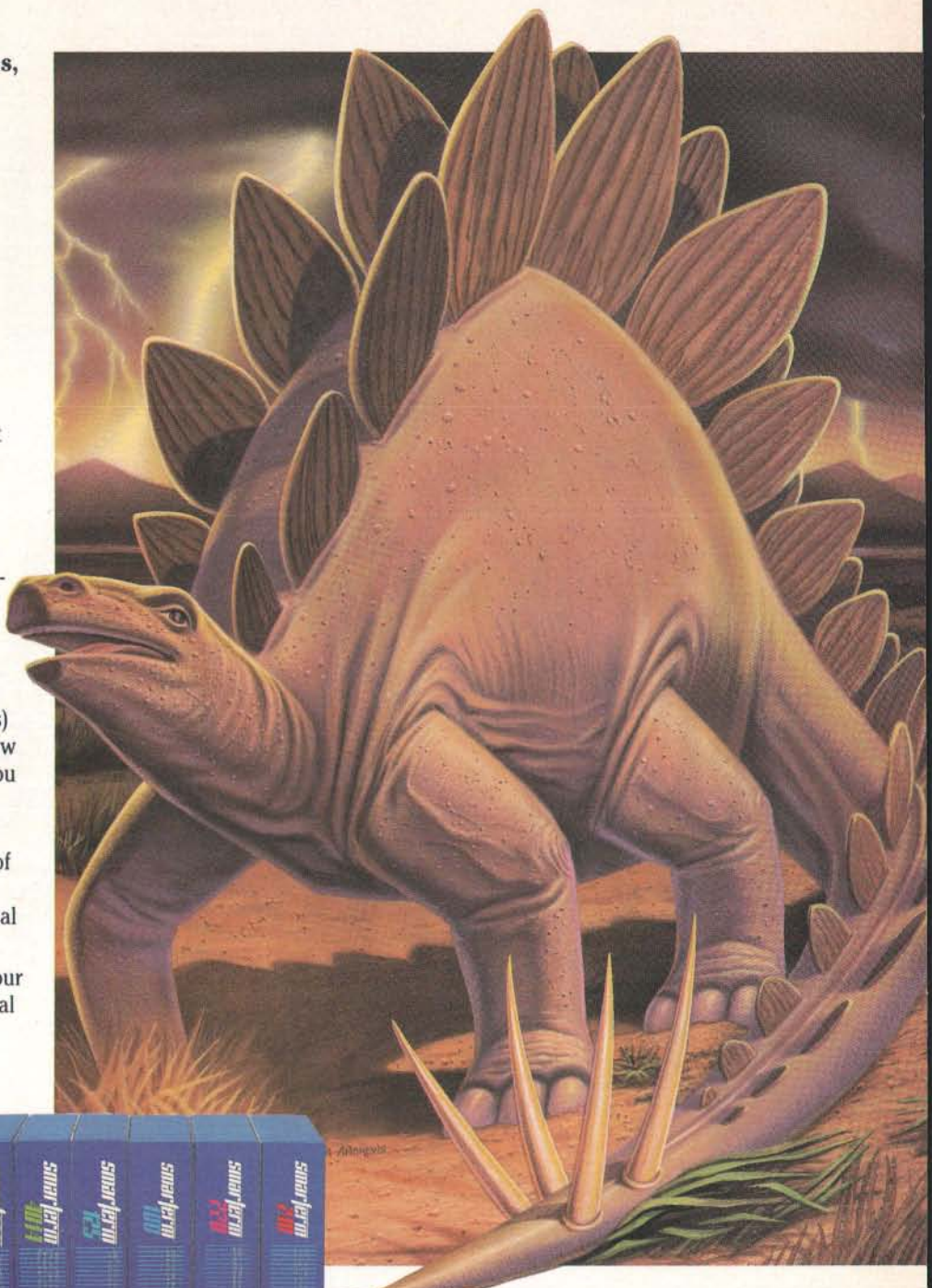
SmarTerm 240, the latest in the SmarTerm series, not only provides the ReGIS* and Tektronix* graphics capabilities of a DEC* VT240* terminal, but adds capabilities that are only possible through the power of a PC.

Features like error-free data transfer (using Kermit or XMODEM protocols) and programmable softkeys. And now with the new add-on network kit, you can communicate through several popular networks.

SmarTerm 240 is just one example of the most advanced line-up of DEC, Data General* and Tektronix terminal emulation software in the industry.

Make the "natural selection." Ask your local dealer about SmarTerm terminal emulation software. Or contact:

Persoft, Inc.
465 Science Drive
Madison, WI U.S.A. 53711
(608) 273-6000
Telex 759491





persoft®

Inquiry 230

SmarTerm Terminal Emulation Software
. . . The Natural Selection

*Persoft and SmarTerm are registered trademarks of Persoft, Inc. IBM is a registered trademark of International Business Machines, Inc. DEC, VT and ReGIS are trademarks of Digital Equipment Corporation. Tektronix is a registered trademark of Tektronix, Inc. © Persoft, 1987. All rights reserved.

MICROBYTES

Staff-written highlights of developments in technology and the microcomputer industry.

Genetic-Management Software Helps Biologists Save Endangered Animals

Biology researchers at the University of California's San Diego campus have proven what a lot of people have suspected for a long time—computers are for the birds. Biologists here are using Ped-Pak, a genetic-management program originally written to help save certain endangered captive species such as the California condor. The program, written by professor Mike Gilpin, consists of a database that contains all known pedigree information about an endangered species (the "stud book") and a projection model that makes offspring predictions (based on hypothetical matings) two or three generations away. Different species can be monitored by simply using the projection model with a different database.

The purpose of the program, according to Gilpin, is to prevent harmful in-breeding among endangered animals in captive environments like zoos. "As the in-breeding coefficient goes up, so does the death rate," Gilpin explained. By tracking the ancestry of captive animals and making projections along the way, biologists can avoid problems as far as five years away.

Gilpin wrote the program in VAX-11 BASIC on a UCSD computer. Since few, if any, zoos have access to a mainframe, Gilpin ported the program first to a Macintosh and then to an IBM PC. The early microcomputer versions were coded in both C and Microsoft BASIC. Since the pedigree-tracking portions of the program depend upon recursive algorithms, however, he switched to True BASIC, which supports recursion for the final version of the program. "The only difficult part of the programming was making the software user-friendly enough," Gilpin said. He said that had he used the Macintosh Toolbox routines, "it would have been much simpler, but I knew I would have to port it to the IBM PC, since not very many zoos have Macs."

Virtually every zoo in the US and Europe is taking part in a program established four years ago to control the breeding of endangered captive animals. Gilpin said he expects Ped-Pak will be adopted as part of the program.

Sensor Provides Inside Look at Integrated Circuits

An electro-optic sensor that lets engineers look inside the circuitry of integrated circuits and make on-chip measurements has been developed by researchers at Stanford University's Ultrafast Electronics Laboratory (Stanford, CA). The sensor, which uses laser beams and fiber optics, has so far been able to measure microwave signals of up to 40 gigahertz on gallium arsenide devices, but researchers believe the device should be able to measure signals in the 100-GHz range. Frequencies measured on silicon devices have been in the 200-megahertz range.

When probing a circuit, a laser beam is split into two parts, with one part aimed at a standard reference point and the other at the junction region or gate. The two beams are then reflected and combined. The resulting optical index produces a "very efficient readout" and can then be measured, said professor Bert Auld, who, along with professor David Bloom, developed the sensor. Silicon integrated circuits are measured in real time, while stroboscopic snapshots are taken for measurements of GaAs chips.

Semiconductor manufacturers have expressed interest in the sensor because such a device will enable them to quickly test a chip as it is being developed. "As they process the chip, [they can] measure what the electrical properties are, so that if something goes wrong at a certain stage, they can correct it," Auld said.

NANOBYTES

The Astronomical Society of the Pacific has published a list of microcomputer software for stargazers and planet watchers. The eight-page "Computer Software for Astronomy" contains annotated listings of 89 astronomy-related programs. The nonprofit group will send you a copy if you send a $2 donation to ASP, Computer List Dept., 1290 24th Ave., San Francisco, CA 94122. Add $1 for postage if you live outside the United States.... For $4995, **Symmetric Computer Systems** (San Jose, CA) is selling a 22-pound transportable computer called the 375, based on a 10-MHz NS 32016, that comes with a 50-megabyte Winchester disk, 1-megabyte 5¼-inch floppy drive, 2 megabytes of RAM, four serial ports, one parallel port, 4.2 BSD UNIX, and eight languages: C, FORTRAN, Pascal, BASIC, APL, Prolog, LISP, and Assembler.... The **Apple Programmers and Developers Association** (Renton, WA), a project of the Seattle-based A.P.P.L.E. Co-op, is offering the Macintosh Programmer's Workshop, an assembly language environment that includes an editor/command interpreter plus an assembler, linker, debugger, ROM interfaces, resource editor, resource compiler/decompiler, and utilities. It sells for $100. APDA annual dues are $20; you can phone them at (206) 251-6548.... Top speed awards go to **gallium arsenide**: Researchers at **Hughes Aircraft** built an integrated circuit that runs at 18 GHz, and scientists at **Bell-Northern Research** fabricated a multiplier chip that can multiply two 4-bit numbers in 1 nanosecond.... **Asahi Glass** (Tokyo) and **Komag** (Milpitas, CA) are

continued

developing glass substrates for use in high-capacity sputtered thin-film disks. The joint venture says the first glass disks will let designers build 5¼-inch Winchesters with capacities as high as 90 megabytes and 3½-inch drives that can store 40 megabytes.... **Infoscience Services** (Northbrook, IL) has scheduled its Computer Aided Laboratories Symposium and Exhibition for May 12–14 at the Sheraton O'Hare in Chicago. The symposium will focus on laboratory automation and will include sessions on lab networking, communications, chemometrics, artificial intelligence, robotics, and data acquisition. To acquire more data, phone (312) 291-9161.... **MicroPro International** (San Rafael, CA) said it's planning a new version of WordStar 2000 for this year, which will have desktop publishing features, and a publishing package being designed by Island Graphics.... Vanna White fans, get ready. **ShareData** (Chandler, AZ) will be coming out with software games based on television shows "Wheel of Fortune," "Jeopardy," and "Family Feud."... We'd like to close with a fond farewell to **The Homebrew Computer Club**, which held its last meeting in December. Long-time moderator Lee Felsenstein said the group, which served as a breeding ground for computer innovations and Silicon Valley companies, would meet again on "special occasions." At the last meeting, one member speculated, "If it wasn't for Homebrew, the first personal computer might have come out of Route 128 in Boston and been called The Maple or something."

Art and Technology a Wonderful Mix; Remember, Michelangelo Was an Engineer

Akram Midani, dean of the College of Fine Arts at Carnegie Mellon University (Pittsburgh), stated in a recent interview that, contrary to popular belief, art and technology have historically been closely intertwined and that computers will have a tremendous impact on art, probably creating new art forms. Midani thinks the debate between art and technology is somewhat artificial. The artist, he says, deals with a whole body of technical knowledge of some sort. Midani points to Leonardo da Vinci and Michelangelo as artists who were highly proficient in technology. Leonardo's technical prowess is well known, but few realize that Michelangelo was also an engineer and an architect.

We are now, according to Midani, at the very early stages of development of art with a computer. Rock music, says Midani, explores technology fully. Much of today's rock is the result of devices such as synthesizers, digitizers, and samplers.

Midani thinks too many computer artists expend too much effort on the same old thing: creating printouts. He claims computer artists are merely trying to create prints without getting their hands dirty. Computer art should be "art of time," not just art of space, he says.

He sees four stages in the development of a new artistic technology. In the first, there is an ambiguous fascination with the capabilities of the new technology. In the second stage comes an understanding of the usefulness and efficiency provided by the technology. In the third stage, the new technology begins extending and altering longstanding views. And the fourth stage marks the dawning of a tremendous change, which is really a new art form. Midani believes that computers are now somewhere between the first and second stages.

Microcomputers, according to Midani, are having an enormous effect on art. He compares them to the paint tube, which freed artists from having to mix their own paints and opened up the art form to large numbers of amateurs. Like the paint tube, the microcomputer invites novices to explore the new artistic possibilities of the medium.

Synaptics Hopes to Cast Neural Nets in Silicon

The father of the Z80 microprocessor and one of the developers of silicon compilers have joined a Silicon Valley company that's trying to make computer chips that mimic the nervous systems of animals. If Synaptics Inc. (San Jose, CA) can make the concept work, the payoff could include much faster computers, with far more powerful database management capabilities.

The firm was founded to turn the theories of neurobiologist Gary Lynch into useful semiconductors. Lynch developed a model of how nerve cells transmit and store information, the so-called neural net. Neural nets are much more highly parallel than present-day computers, with processing power distributed throughout the net. They store and access information based on content rather than a specific location. By casting neural nets in silicon, researchers hope to bring these capabilities to computers.

Among the people working with Lynch at Synaptics is Frederico Faggin, who worked on the design of the 8080 microprocessor for Intel and then moved on to cofound Zilog and help design the Z80. The company's most recent acquisition is Carver Mead, who helped develop silicon compilers to speed the process of turning chip designs into silicon. In addition, Mead is an expert on how the neurons in the human eye process data.

Atari to Roll Out Number-Crunching STs

Atari Corp. (Sunnyvale, CA) confirmed that it plans to introduce 32-bit-based ST workstations sometime in the second half of this year. "Basically there are two hardware components: a number cruncher and a higher-resolution ST," said Neil Harris, director of marketing communications for Atari. "The number cruncher plugs into the DMA port on either the current ST or the enhanced-resolution ST."

Harris said the "number cruncher" is a 68020-based system with a math coprocessor (68881) and memory management unit. It will run UNIX System V software "or something close to it," said Harris. The workstation will use the Atari ST as a front end or as a kind of "genius terminal" (using the DMA port) and the ST's keyboard, graphics, and other I/O.

We invented the modem that makes fewer demands on your PC.

The Ven-Tel Half Card™ modem. All the power and speed of our regular modems, but with some major advantages for people who demand versatility from their PC.



Regular modems plug into one of your computer's full-size slots. Just like expansion boards—color boards, graphics cards and memory expanders.

The Ven-Tel Half Card modem is different. It plugs into a short slot, freeing up a long slot so your PC can handle an additional function. And while other modems have about 300 components, ours has 70. So it not only demands less space from your computer—it also demands less power and generates less heat. Your PC stays cool and stress-free.

Competitively priced, the Half Card modem is available in both 1200 baud and 2400 baud speeds. And it's backed by Ven-Tel's free *five-year* warranty. No other major manufacturer even comes close.

If you make a lot of demands on your PC... demand the less-demanding modem: The Ven-Tel PC Modem Half Card.

Ven-Tel
Modems

Our free 24-page booklet, "How To Select The Correct Modem," contains specific information about our full line of modems. To request your copy, call 800-538-5121. In California, call 408-727-5721.

Inquiry 321

Process Uses Neutron Beams to Test GaAs, Silicon Crystals

Although neutron beams are often associated with future weapons systems, they may also provide a lower-cost way of producing semiconductor chips. The reason for this is a newly proposed method of testing for crystalline defects in semiconductor wafers. Canada's Chalk River National Laboratory has made available for commercial use a testing process in which neutron beams from a nuclear reactor are used to spot flaws in gallium arsenide or silicon crystals.

The test is based on the phenomenon of neutron extinction. Simply stated, a beam of neutrons can be reflected by a crystal structure, but the intensity of reflection varies with the perfection of the crystal. Significantly, since the reflection occurs in the body of the crystal, not just at the surface, the reflection intensity is a measure of the perfection of the whole crystal at once. The test method is said to be nondestructive, and induced radioactivity is said to be minor.

Most semiconductor wafers are currently tested using an "etch" test in which three wafers are picked from a group of about 20. The three samples are destroyed in the process, and the quality of the remaining wafers is extrapolated from the results of the test.

Since the Chalk River test is nondestructive, rapid, and inexpensive, it can be used to test all wafers and can thus achieve more accurate results.

Chalk River has tested the technology with GaAs and silicon wafers and is negotiating with a number of semiconductor manufacturers. According to Paul Browne, business development manager for the laboratory, the new testing method should eventually lower chip production prices.

VLSI Could Be Approaching Its Limits

Very-large-scale integration may be approaching the limits of its growth, according to a panel of experts at the International Electronic Devices Meeting in Los Angeles. The basis of VLSI is cramming more devices, such as transistors, onto a single piece of silicon. For the past 20 years or so, the device density per square inch of integrated circuits has doubled every few years, resulting in more powerful microprocessors, higher-capacity memory chips, and less-expensive computers.

According to the panelists, this process can't continue for more than one or two more generations. A combination of fundamental roadblocks, technology problems, and soaring costs will put an end to the cycle.

As device density increases, devices have to become smaller. Today, 2- to 3-micron geometries (the minimum distance between features on the chip) are standard; many advanced chips are using 1-micron geometries, and 0.1-micron geometries are being explored. Devices will eventually become so small that the effects of electric current flowing through the circuit will tend to cause connections to break. This is called "electromigration wearout." Another form of wearout, "hot electron wearout," will affect the thinner oxide layers of the smaller devices. The result is that IC reliability and life expectancy will decrease.

But high costs might curb VLSI before device physics does. Each generation of chips has been more expensive to design and produce, and the panelists agreed that the trend shows no sign of abating.

Common LISP Acquiring Object-oriented Features; Seeking a Standard

Common LISP, the standard version of the LISP programming language, took several years to evolve, so it is no surprise that the evolution of an object-oriented (OO) enhancement to Common LISP will be a similarly lengthy task.

At a meeting of an ANSI subcommittee in Dallas, an administrative framework was set for the development of the new standard OO enhancement. The LISP community is said to have already made it clear that it favors the Common LOOPS dialect as the basis for the new enhancement. There are, however, two other candidates: Flavors, from Symbolics (Cambridge, MA), and Object LISP, from LISP Machine (Andover, MA). Their respective proponents are expected to lobby for inclusion of some of the stronger features of these dialects. By the time of the next meeting, scheduled for this month, a tentative spec for the new OO extension will be circulated; a final spec is not expected until early 1988.

Despite the lack of an OO standard, implementors of LISP on microcomputers are going ahead with variations on at least two of the above-mentioned dialects.

ExperTelligence (Santa Barbara, CA), which is now offering a full version of Common LISP for the Macintosh Plus, is including an OO capability similar to an enhanced version of Flavors. Coral Software (Cambridge, MA) will offer a version of Common LOOPS with its Mac-based Common LISP system, which it hopes to have available by summer.

And Gold Hill (Cambridge, MA), which now sells a subset of Common LISP for the IBM PC AT, will offer another variation of Flavors for its full Common LISP system for the AT and 80386 systems, due around April. Gold Hill said it might also offer versions of the other two dialects if customers request them.

TECHNOLOGY NEWS WANTED. *The news staff at BYTE is always interested in hearing about new technological and scientific developments that might have an impact on microcomputers and the people who use them. We also want to keep track of innovative uses of that technology. If you know of advances or projects that involve research relevant to microcomputing and want to share that information, please contact us. Call the Microbytes staff at (603) 924-9281, send mail on BIX to Microbytes, or write to us at One Phoenix Mill Lane, Peterborough, NH 03458.*



THANKS FOR THE MEMORIES

Have you ever noticed how time seems to change everything? Fashions change. Technology changes. Even the microcomputers we use change. Maybe that's why so many of our customers are saying goodbye to IBM in favor of a "good buy" from Wells American.

As time goes by, more and more computer users are realizing what an extraordinary value our A★Star II® truly is. It's the *only* AT class microcomputer that can run at 6, 8, 10 *and* 12 MHz! It's also the *only* PC/AT compatible that's "network ready." Better yet, each A★Star II now comes with your choice of keyboards - the original AT version or the enhanced "RT" style. Best of all, A★Star II prices start at only $995!

But what about quality and support? Don't worry! We've been making microcomputers *longer* than IBM! And it shows. Our A★Star® computers have been top rated by leading industry trade journals. Even so, we've heard that some "big blue" old-timers still worry about trading their IBM "security" blanket for better priced, higher performance equipment. (Remember how difficult it was to give up *your* baby blanket?) That's why we've arranged for RCA, one of the world's largest technical service organizations with 18,000 employees, to provide low cost, nationwide maintenance for our A★Star II. And if that's not enough, every unit includes free schematics and a no risk money-back guarantee.

THE A★STAR II IS MADE IN THE USA.



Still need a blanket? We've got you covered! Try out one of our A★Star II's and we'll send you one. It's baby blue, monogrammed and...it's absolutely free! We'll also include a $395 option, at no charge, with your first A★Star II purchase. This offer *is* limited, so call or write us today. Just because you'll be saying goodbye to IBM doesn't mean you'll have to say goodbye to quality, support *or* security. Besides, at least you'll still have your memories...and your money!

Wells American®

Corporate Headquarters: 3243 Sunset Boulevard • West Columbia, South Carolina 29169 • 803/796-7800 • TWX 510-601-2645

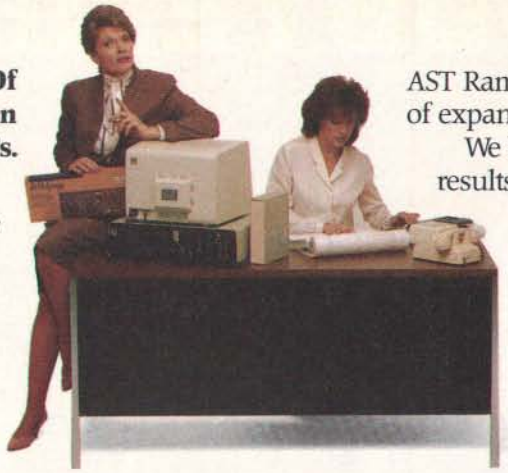
IBM, Personal Computer AT and AT are trademarks of International Business Machines.

"Rampage® With 2 Megabytes Of Memory Is The Perfect Addition To Our Installed Base Of PC/XTs.

For years we've equipped all of our PCs with AST products, like SixPakPlus.® But, Debbie ...here in accounting...needed more than 640K for her Lotus® 1-2-3® expanded memory spreadsheet. She suggested an AST Rampage board with two megabytes of expanded memory.

We bought her the Rampage and the results were incredible. Now, Debbie is able to fully use her expanded memory applications.

Debbie has been promoted. And now all of our older PCs and XTs have Rampage boards!"



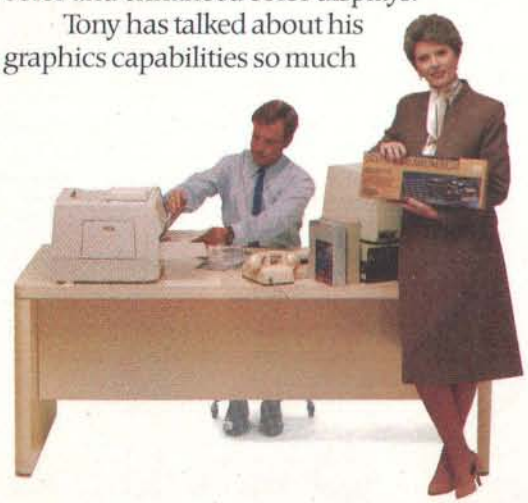
"AST's Premium Ser Flexibility In

"With SixPakPremium/EGA We Have a Versatile, Multifunction/Memory/Graphics Solution In A Single Slot.

Meet Tony, our Financial Officer. He uses expanded memory for large spreadsheets, a parallel port for his printer, a serial port for a mouse and EGA capabilities for eye dazzling color graphics.

His XT is equipped with SixPakPremium/EGA. It delivers all the features of SixPakPremium with complete graphics capabilities—on a single board. And it's compatible with popular monochrome, color and enhanced color displays.

Tony has talked about his graphics capabilities so much





"For New PC/XTs, SixPakPremium™ Gives Us The Right Combination Of Multifunction Features and Expanded Memory In A Single Slot.

Today is Jim's first day. His new PC XT is equipped with AST's SixPakPremium. It gives him all the features of a SixPakPlus and Rampage—combined into a single slot.

Even though Jim only needs one megabyte of memory now, as he develops his skills and projects, he'll be able to add a second megabyte of memory to the SixPakPremium board. There's also a serial port, parallel port and battery-backed clock/calendar.

Jim represents a new generation in the company. So does SixPakPremium. They're the future."



...es™ Boards Give Us Tailoring Our PCs."

that now other departments are requesting SixPakPremium/EGA... Engineering, Sales, even Advertising.

We trust Tony to know finances. And he's found us a bargain in SixPakPremium/EGA."



"How We Increased Our Productivity With The AST Premium Series!

To take full advantage of expanded memory, AST includes an operating environment software package with every Premium Series board. With it Jim, Debbie and Tony can load applications into memory once in the morning. Then they're able to move instantly between the applications and even execute multiple tasks at the same time.

For example, they can sort a dBASE III® file, calculate a Lotus 1-2-3 spreadsheet and edit a WordStar® document all at the same time... on the same PC."

To Learn More Call AST Today at (714) 863-1480. Or send the coupon to AST Research, Inc., 2121 Alton Avenue, Irvine California 92714-4922, Attn: M.C.

AST markets products worldwide—in Europe call: 441 568 4350; in the Far East call: 852 0499 9113; in Canada call 416 826 7514. AST, the AST logo, Rampage and SixPakPlus registered trademarks and Premium Series and SixPakPremium trademarks of AST Research, Inc. Lotus and 1-2-3 registered trademarks of Lotus Development Corp. dBASE III registered trademark of Ashton-Tate. WordStar registered trademark of MicroPro International. Copyright © 1986 AST Research, Inc. All rights reserved.

YES! Send me more information today on AST's Premium Series.

Name _____

Title _____

Company _____

Address _____

City/State/Zip _____

Telephone ( ) _____

Send to: AST Research, Inc., 2121 Alton Avenue, Irvine, California 92714-4922, Attn: M.C.

01 B B058 B01 PC 3/87



AST® RESEARCH INC.

LETTERS

All Together Now

As the user of an Amiga text editor and word processor at home, and of two different word processors at the two offices where I work, I feel that there is a need for a low-level text-editing standard.

For example, to move the cursor to the end of the line it's on requires a different command for each of the word processors I use. An agreed-upon standard employing intuitively simple keystrokes like Ctrl-right arrow (the arrow keys, once unavailable to many CP/M users with dumb terminals, are now built into every "real" computer except the Macintosh) to move the cursor to the right end of the line would greatly simplify things for many users. All universal editing functions, such as cursor navigation, search and replace, block delete and copy, and help cues, could be invoked with the same keystrokes. Software vendors could benefit through reduced learning time, due to familiar commands. This would increase the appeal of their products.

Major changes to existing software needn't be implemented. Rather, developers might just include a software toggle whereby users could choose between using a program's own unique editing commands and the standardized commands. All such a standard needs to become a reality is backing from a major software company.

Jeff Mings
Hauula, HI

Radon Attention

Referring to the letters from Howard Mark and Forrest Mims III ("CRT Radiation," November 1986), I must point out that there is already a large body of academic literature on this topic. The *Health Physics Journal* and National Institutes of Health studies indicate that CRTs do not emit harmful amounts of radiation. Recently, it was speculated that radon gas may be a radiological health hazard. The *Health Physics Journal* published a study that indicates that CRTs attract radon gas because of the electric field created by the scanning electron gun.

Although it is possible to measure the radiation emitted by CRT devices outside the laboratory, the results reported by Mr. Mims must be interpreted as "below the lower limit of detection" because of the statistical nature of radiation detection. I encourage readers of BYTE to measure the radiation emitted by CRTs. However, they should use proper statistical methods when analyzing the results.

Mitchell F. Wyle
Zurich, Switzerland

Assorted Flavors

I'm pleased that Seymore J. Metz knows an outrageous claim when he sees one ("Sort Run Times," December 1986), and I certainly wouldn't want to be taken seriously about a linear time claim for a sort algorithm. My distinction between theory and practice was meant to indicate that, although no general algorithm will sort in less than $n \log n$ time, it is sometimes possible within practical situations to achieve results that are effectively linear. Specifically, within a wide range of sizes useful to me, I was able to sort files with exactly two reads and two writes per record.

My original description was undoubtedly less than clear, especially since I hadn't had any reason to generalize the sort beyond its two-pass version. The generalized version turns out to be a variation on the merge sort. The following may help to clarify:

Sorts come in at least three flavors: sorts that will fit entirely into RAM, sorts of data many times the size of available RAM but which fit entirely on direct-access storage (disks), and sorts of data too big for available disk space, which require multiple tape drives. My situation required the sorting of a disk file several hundred times the size of RAM job space, in a format our sort utility couldn't handle. The specific memory and file sizes aren't important, only relative sizes. Sooner or later, everybody is going to have to do an external sort. Just hope you can do it without resorting to tape.

Sort objectives come in any number of flavors. Since I was planning on late-night runs, my sole concern was total elapsed time for the job, which meant minimizing disk access and letting the CPU cycles fall where they might.

The common choice for external sorting is the merge sort, which is primarily a tape sort. A file with n records is read into available memory m records at a time, sorted, and written out to two new tapes, which will then contain n/m groups (or runs) of m records each. The two tapes are merged to produce two new tapes with $n/2m$ runs of length $2m$. These produce tapes with $n/4m$ runs of length $4m$, and so on, until one tape contains one run of length n. The merge sort runs in $n \log n$ time, specifically ($n \log_2 (n/m)$) or thereabouts. A simple improvement uses memory as a buffer to increase the size of the output runs and therefore increases the speed of the sort by about a factor of 2.

My suggestion is to use internal memory to increase, not run size, but the number of runs being merged. After the initial pass, we have n/m runs of length m. On the next pass, why not create n/m^2 runs of length m^2, then n/m^3 of length m^3, and so on? Note that this won't work with tape, but on disk it's easy to treat one input file as multiple segments via record access.

The time of this sort (in disk access) is still $n \log n$, but it's about $n \log_m n$. With only 300 records in memory, this could still cut elapsed time by 75 percent over the improved merge sort. A file of 90,000 records would be sorted in two passes instead of about six with the improved merge. A hefty 100 million records is finished in four passes, not fourteen. There is some increased CPU overhead with this variation, but, in my case, I could afford it.

In fairness to my former employers, a few million in sales and a staff of 40 may not be multinational, but we liked to think of ourselves as far from trivial or irrelevant. In Northeast Ohio we know a different big word—unemployment.

John W. Ward
Waynesburg, OH

Updating ASCII

Robert Sneddon has hit on an idea I have been kicking around for about a year now ("In Search of Cheaper Transmission,"

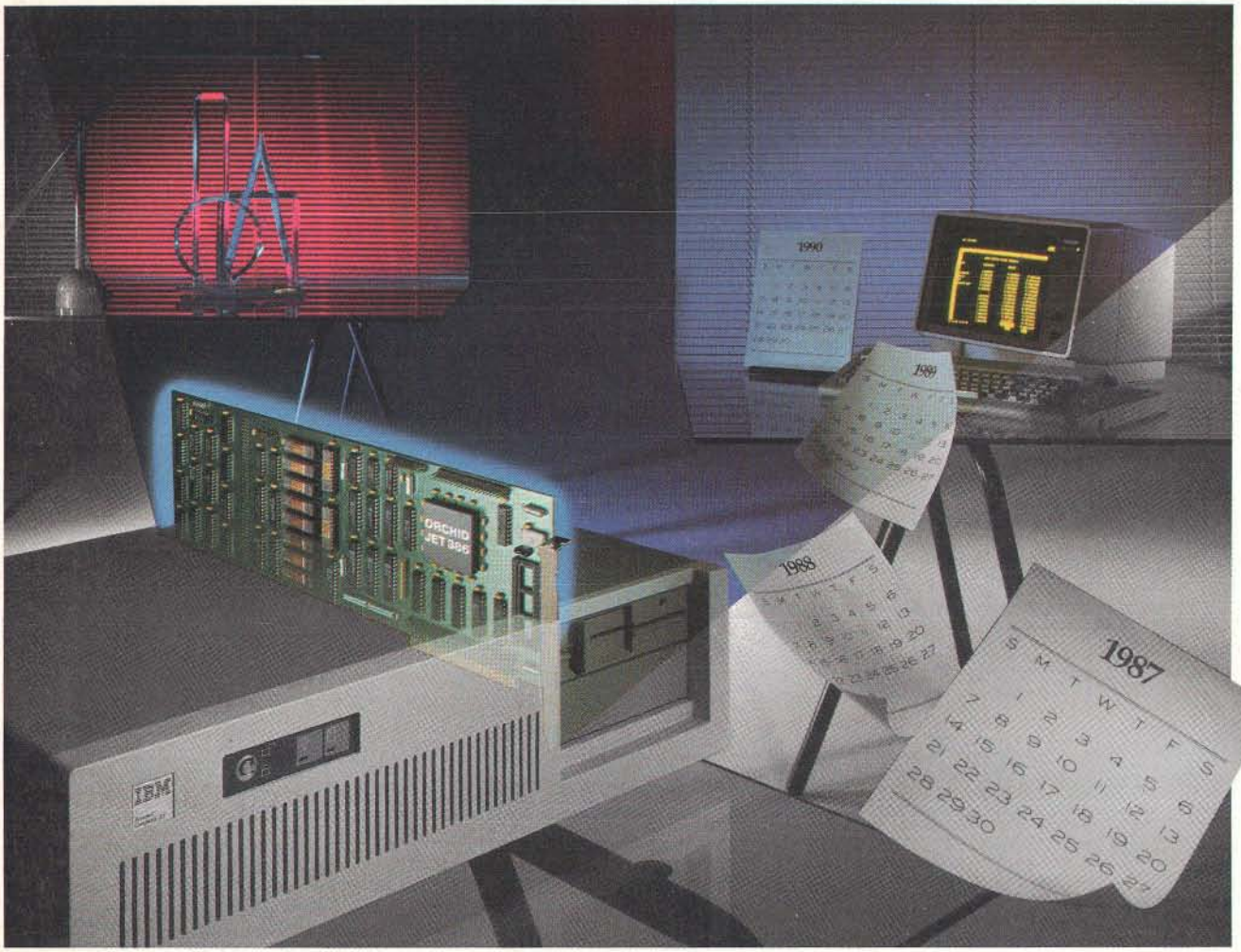
continued

LETTERS POLICY: *To be considered for publication, a letter must be typed double-spaced on one side of the paper and must include your name and address. Comments and ideas should be expressed as clearly and concisely as possible. Listings and tables may be printed along with a letter if they are short and legible.*

Because BYTE receives hundreds of letters each month, not all of them can be published. Letters will not be returned to authors. Generally, it takes four months from the time BYTE receives a letter until it is published.

ORCHID'S JET 386™: POWER FOR THE FUTURE NOW

SPECIAL PRICE $1199.00



Jet 386 is the Ultimate Accelerator Upgrade for Your AT

Announcing an end to obsolescence. Orchid Technology's Jet 386™ accelerator card extends the life of your computer investment into the 1990s—it puts power in your AT that you won't outgrow.

Three Times Faster than an AT

It's up to three times faster than an AT depending on the application, and speed is just one benefit. Unequalled compatibility and provisions for upcoming 386 software mean your Jet 386 will handle whatever the future has in store: CAD, spreadsheets, networking...

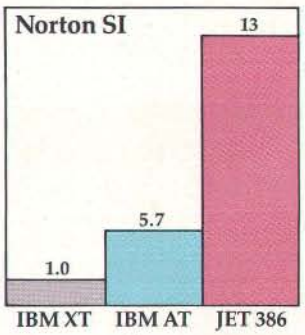
Easy Upgrade

Easy to use, there's nothing new to learn and no new programs to buy. At 25% of the cost of buying a new 386 PC, it's easy on your pocketbook, too.

From the People Who Started It All

Orchid combined 80386 power with the technology perfected for the XT in the TinyTurbo and PCturbo 286e. Like these critically acclaimed accelerators, Jet 386 is built for lasting value.

Call Orchid to find out how you can experience the future today. And ask how Orchid can modernize your whole office with turbos, graphics, networking, and multifunction products.



ORCHID

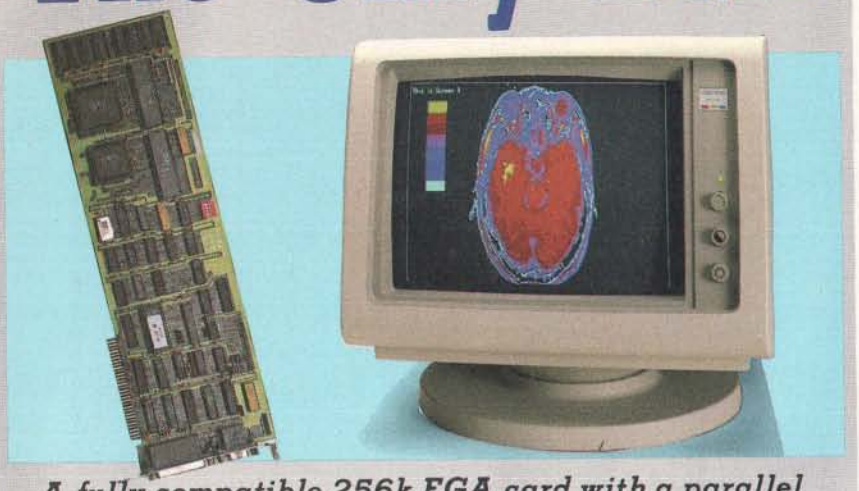
Building for the Future

45365 Northport Loop West
Fremont, CA 94538
415/490-8586 Tlx: 700280

Inquiry 211 for End-Users.
Inquiry 212 for DEALERS ONLY.

Jet 386, PCturbo 286e and TinyTurbo 286 are trademarks of Orchid Technology. All other products named are trademarks of their manufacturers.

The Only EGA



A fully compatible 256k EGA card with a parallel port for only $209. If you buy any display card: Color, Monochrome, Hercules, or EGA, without reading this ad, you're probably throwing away a lot of money.

BT/EGA Enhanced Graphics Adapter: 256k of memory, and parallel printer port. Works with all standard IBM displays, and compatible displays.
5150 Monochrome Display: Both text and 640x350 bit mapped graphics.
5153 Color Display: 640x200 and 320x200.
5154 Enhanced Display: Color 640x350 16 simultaneous colors from a palette of 64.

A Clear Upgrade Path

This really is the only display board you may ever need. Regardless of what monitor you buy today, this card is a clear upgrade path for the future, and the best choice today, even if you are only going to use a Monochrome Display. This means one board today does monochrome 640x350 bit mapped graphics and text, and provides a clear upgrade path to 640x350 Enhanced Color Display with no change of display board. It also runs with the 640x200, 320x200 Color Display.

Killer Features

All boards come with a full 256k of memory, and a parallel printer port. That means no extras for later, and 16 simultaneous colors displayed from a palette of 64 colors, and crisp clear text on both Monochrome and Enhanced Color Displays - features or options that are not available on some EGA boards. Since all your current software will run, you're set for today, and prepared for the standard of the future.

The Display Deal

Of course, many of you will want to take advantage of the EGA card right away, so we are offering a special deal when you buy the board together with a Basic Time HR 31-350 monitor - you get both for just $649, or the card only, for $219. In addition to our fine products, Qubie' offers unparalleled service which includes our **30-Day No Risk Guarantee**, one year warranty, **48-hour turnaround** and **Federal Express** on warranty repairs, and our **Technical Support Line** open Saturdays 8 - 11am PTZ.

No Risk Guarantee

If you are not completely satisfied with your purchase, you may return it within 30 days of purchase for a complete refund, including the cost to send it back. If you can get any dealer or competitor to give you the same **No Risk Guarantee**, buy both and return the one you don't like.

VISA master charge

For fastest delivery, send cashier's check, money order, or order by MasterCard/Visa. Personal Checks allow 18 days to clear. Company purchase orders accepted, call for prior authorization. California residents add 6% sales tax.

QUBIE'

Department B
507 Calle San Pablo
Camarillo, California 93010

Inside California
805-987-9741

Outside California
800-821-4479

London (01) 223-4569 Sydney (02) 579-3322
Paris (01) 321-5316 Canada (403) 434-9444

Hours: M-F 8am - 5pm PTZ
Sat 8am - 11am PTZ

November 1986). He mentioned updating the ASCII character set and 16-bit micros, but did not link the two. That is the key to what I wanted to do. Text compression wasn't the main aim of the technique I worked out. I decided to take advantage of the 16-bit word length of most sensible computers. I decided that the enormous investment in 8-bit (ASCII) software would prevent any drastic changes. Then I looked at ASCII closely. Most text can be written using only 7 bits; 7-bit ASCII. The eighth bit is wasted on obscure graphics characters (which are not standardized anyway). I decided to use 7-bit ASCII as a basis for a standard using 16-bit words.

If bits 7 and 15 are both 0, a word represents two 7-bit ASCII characters. If either is set, then the word as a whole represents something else. This leaves 48K characters in the standard character set. Effectively, the ASCII character set is mapped 128 times into a 64K set. Losing some space in the map is an acceptable compromise if it avoids taking up twice as much space for text.

I had wondered what to put into the set after Greek, Chinese, Arabic, and Japanese characters. Perhaps I should look closer at the word count in representative samples of text. It would be easy to include, say, 4000 words in the standard set. Personally, I would include all of the most commonly used words plus all of those spelled differently in the U.K. and the U.S. You, too, could write *English*!

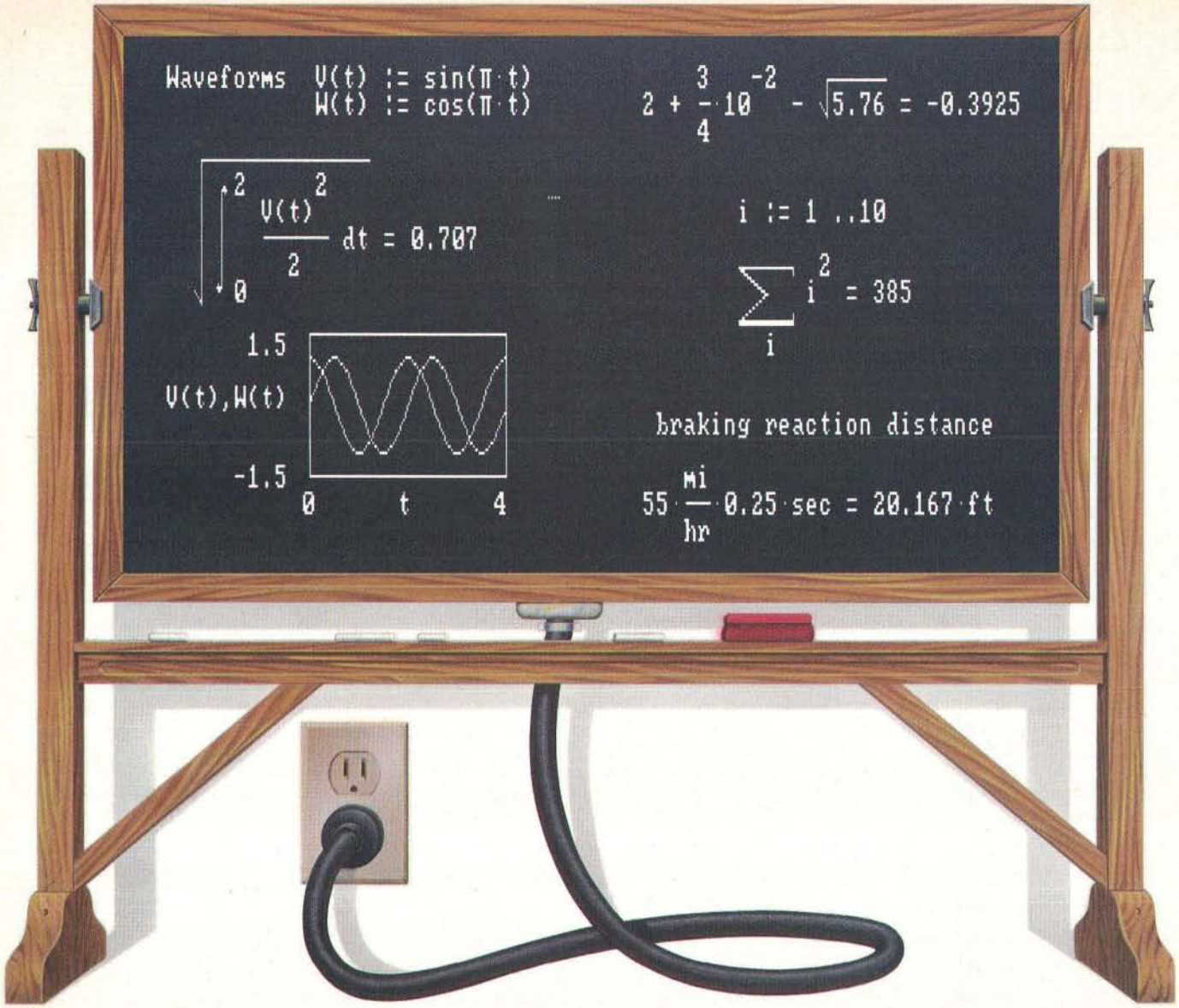
In addition to all of the usual text characters, the character set would include control codes for font changes, paragraph-end, soft hyphen, boldface, underline, proportional spacing, and all the other functions needed in typesetting text. If this develops into a real standard, it should control the way unsupported functions should be handled. It may be quite a while before anyone develops flashing ink.

Colour (I did say English) is a problem. It would be possible to use 16 codes for foreground and 16 for background colours. This seems too limiting. Now that computers are starting to use colour seriously, it might be better to use an escape sequence. One character would represent the message "The word following this is a binary representation of the new foreground colour." For the near future, 64K foreground and 64K background colours should be enough. Until the new 32-bit character set is introduced, of course.

There are practical problems in applying this new standard to existing machines. Most of them can be dealt with by using filter programs, which would expand the nonASCII codes into escape sequences, possibly the ANSI codes.

continued

Inquiry 249



Engineering calculation raised to a new power.

The only software program to combine the flexibility of a blackboard, the simplicity of a calculator, and the power of a personal computer.



Now you can write calculations on your PC in standard math notation—mixing text, formulas and graphics with the same free-form ease you have on a blackboard or scratchpad.

No new languages to learn. Simply type equations anywhere on the screen and MathCAD automatically calculates and displays your results as numbers or graphs—exactly as you want to see them. Change anything, and MathCAD instantly recalculates the results. Add text at any point to support your work. Then print and save your entire calculation as an integrated document.

Powerful built-in functions. MathCAD handles both real and complex numbers and does automatic unit conversion and dimensional analysis. It has a full range of built-in functions including integration, differentiation, fft's and cubic splines. Or you can define your own. No wonder thousands of engineers use MathCAD every day, for everything from robotics to signal processing and thermodynamics to fluid mechanics.

Call us today.
We're convinced that MathCAD belongs on every engineer's desk. At $249, with our no-risk, 30-day money-back guarantee, you really can't afford not to try it. To place your order or to request further information, call us now at:

1-800-MathCAD

(in Massachusetts: 617-577-1017)

MathCAD. Once you've tried it, you'll wonder what you ever did without it. Order today.

Requires IBM PC® or compatible, 512KB RAM, graphics card. IBM PC is a registered trademark of International Business Machines Corporation. MathCAD™ MathSoft, Inc.

MathCAD

MathSoft, Inc., 1 Kendall Sq., Cambridge, MA 02139

C Programmers!

db_VISTA™: high-speed DBMS written exclusively for C NOW offers SQL-based query

High-Speed data retrieval and access... just two benefits of using Raima's network model DBMS, db_VISTA. Combine these design benefits with those of C—speed, portability, efficiency, and you begin to understand db_VISTA's real measure... performance.

Says, *Dave Schmitt, President of Lattice, Inc.*

"If you are looking for a sophisticated C programmer's database, db_VISTA is it. It lets you easily build complex databases with many interconnected record types. Raima's customer support and documentation is excellent. Source code availability and a royalty-free run-time is a big plus."

db_QUERY™: new simplicity retains performance!

db_QUERY, our new C-linkable, SQL-based, ad-hoc query and report writing facility ... provides a simple, relational view of db_VISTA's complex network database. No longer will you give up performance for simplicity ... combine db_QUERY with db_VISTA ... you have both!

- **Written in C**
- **Royalty-Free**
- **Source Code Available**
- **Multi-user and LAN capability**
- **Fast B-tree indexing method**
- **Transaction processing**
- **Faster without Data Redundancy**
- **Complete Documentation**
- **Operating systems:** MS-DOS, PC-DOS, UNIX, XENIX, SCO XENIX, UNOS, ULTRIX, VMS
- **C compilers:** Lattice, Microsoft, IBM, DeSmet, Aztec, Computer Innovations, XENIX and UNIX

30-day Money-Back Guarantee

Royalty Free Price Schedule

	db_VISTA	db_QUERY
Single-user	$ 195	$ 195
Single-user w/Source	$ 495	$ 495
Multi-user	$ 495	$ 495
Multi-user w/Source	$ 990	$ 990
NEW:		
VAX Multi-user	$ 990	$ 990
VAX Multi-user w/Source	$1980	$1980

MasterCard VISA

Call Toll-Free Today!

1 (800) db-RAIMA

(that's 1-800-327-2462)

—OR Call 1-206-828-4636

RAIMA™ CORPORATION

3055-112 N.E., Bellevue, WA 98004 USA
(206) 828-4636 Telex: 6503018237 MCI UW

BY37

Level-0 compliance could be that simple. The real problem will be persuading chip manufacturers to produce the new character set ROMs. A full 48K character set in a 16- by 16-pixel dot matrix would be 1.5 megabytes. This is no problem for computers, but it is too much to expect low-cost printers to include a ROM of that size until plain-vanilla ASCII is the exception instead of the rule.

So far, the whole idea is still in my head; this is the first time I have put anything down in writing. Does anyone else have any ideas?

Bernard Peek
Watford, Hertfordshire, U.K.

Speeding Mandelbrots

Programs that plot the Mandelbrot set can be significantly speeded up by checking for repeating values.

Consider the point (0,0*i*). Repeatedly iterating this value under $z \leftarrow z^2 + c$ always yields the value (0,0*i*). Indeed, if *any* value comes up a second time, it can be said to be "caught" in a repeating cycle of some finite period. Once this occurs, further iterations are a waste of time, and the program can immediately go on to the next point, rather than waiting until some arbitrary number of iterations has been performed.

It turns out that almost all of the points that lie within the Mandelbrot set proper eventually enter a cycle like this. To check for a repeated value, I use a method discussed by A. K. Dewdney in "Computer Recreations" (*Scientific American*, August 1985) for detecting attractors.

First, declare two arrays, one for real and one for the imaginary components of the value being computed. The arrays should range from 1 to the maximum number of iterations you expect to perform for each point. Now, as each new *z* is computed, compare its components against the array elements (iteration count/2). If they don't match, store the values in the array elements (iteration count). If they do match, you have found a repeat and can go on to the next point. I have found that this method cuts the number of iterations needed to determine if a point lies within the set by about 80 percent.

Note that this has no effect on those points that surround the set but don't belong to it. You must still check to see how long it takes these points to exceed a size of 2. Also, the time required to enter a cycle increases for points close to the set boundary, so that the speed increase is greatest for those points that lie deep within the set.

Finally, it is instructive to color-code the number of iterations that occur before a point within the set enters a repeating cycle. It appears that on the boundary itself, the point never repeats the same value and never grows beyond a size of 2. This region is infinitesimally thin and marks the transition between two very different sorts of behavior of the function.

I would very much like to hear from anyone who has found better algorithms for computing this and other fractal objects. Please feel free to write me.

Paul McGregor Carlisle
202 West Harrison
Royal Oak, MI 48067

Peter Schroeder's article, "Plotting the Mandelbrot Set" (December 1986) contains a number of points that merit further clarification.

First, the basic generating formula given at the bottom of the second column on page 207 is in error; it should read $z = z^2 + c$.

Second, the Mandelbrot set is the set of points *c* on the complex plane for which the sequence of complex numbers

$$z_0 = 0,\ z_{i+1} = z_i + c,\ i + 1, 2, 3, 4, \ldots$$

does not diverge, as *i* tends to infinity.

Schroeder gives undue significance to the magnitude of z^{1000}, the number 1000 deriving perhaps from Dewdney's article in *Scientific American*. This number is based on the assumption that if the sequence does not diverge after 1000 iterations, it will never diverge.

As a practical matter, any other "large" number could have been chosen instead. In fact, we have found that the resulting graphic renditions are not materially altered if a cutoff value of, say, 256 is used instead. In so choosing, of course, the computation required for the plot is substantially reduced if the plot includes many points that are members of the set.

Because of the long running times required, here is an application for which optimization assumes real importance. I would suggest that one consider the use of fixed-point arithmetic at the assembler level for the iterative calculation itself. This would require treating *z* and *c* as 16-bit numbers with *i* integer bits and $16 - i$ fractional bits, which can be put back into the original 16-bit format with a $(16 - i)$-bit arithmetic right shift. This approach will realize significant improvements in running time, especially if an 8087 is unavailable.

Benjamin E. Chi
Albany, NY

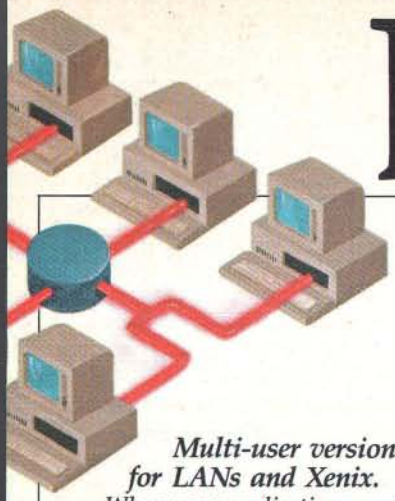
More Updates for ATOMCC

The purpose of this letter is to inform all the users of ATOMCC (written in FORTRAN 66) that, because of all the bugs

continued

Inquiry 255

Btrieve®



The Programmer's Choice.

Whether you're a programming pro or just beginning, there's one thing to remember when developing applications: Btrieve.

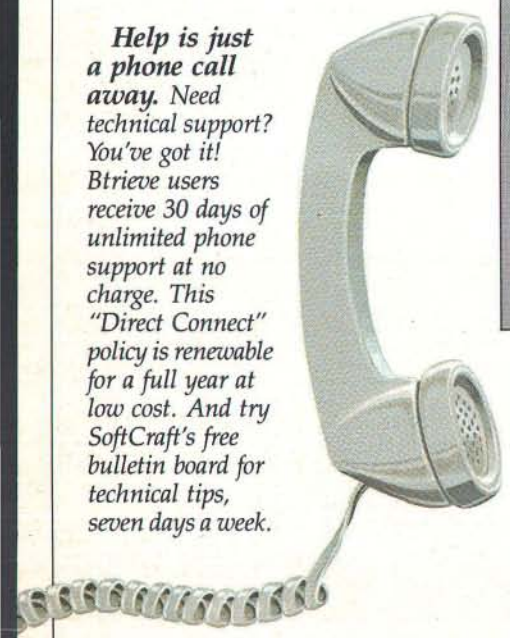
The Btrieve file manager is an alternative to all those DBMSs that promise ease of use—but deliver something far different. Like languages that take weeks to master. Performance that fizzles instead of sizzles. Programs that won't network. Of course you can write applications with these "revolutionary" packages. But someday you'll wish you hadn't.

If you know a programming language, you already have what it takes to build better applications. All you need is Btrieve.

Btrieve is the programmer's choice for file management. But you don't have to be a professional programmer to use it. With Btrieve loaded in your PC, your programs can use simple subroutine calls to retrieve, store and update records.

Multi-user versions for LANs and Xenix. *When your applications need to network, Btrieve's multi-user versions connect you to the industry's most popular LANs: IBM PC Network, Novell Advanced Netware, or any DOS 3 network. Btrieve is also available for Xenix and multitasking operating systems such as MultiLink Advanced, Microsoft Windows and IBM Topview.*

Help is just a phone call away. *Need technical support? You've got it! Btrieve users receive 30 days of unlimited phone support at no charge. This "Direct Connect" policy is renewable for a full year at low cost. And try SoftCraft's free bulletin board for technical tips, seven days a week.*



Thorough documentation, easy implementation. *Getting started with Btrieve is easy: the manual is packed with step-by-step instructions and examples of every Btrieve function in BASIC, Pascal, COBOL and C.*

Btrieve has built-in security features and the ability to handle four billion byte files. ***And there are no royalties on Btrieve applications.***

SoftCraft

P.O. Box 9802 #917
Austin, Texas 78766
(512) 346-8380 Telex 358 200

Suggested retail prices: Btrieve, $245; multi-user Btrieve, $595; Xtrieve, $245; multi-user Xtrieve, $595 (for report generation, add $145 single-user and $345 multi-user). Available from SoftCraft and selected distributors. Requires PC-DOS or MS-DOS 2.X, 3.X, Xenix. Btrieve is a registered trademark and Xtrieve is a trademark of SoftCraft Inc.

B-tree based for high performance. *Performance is all-important, especially as your database grows. That's why Btrieve implements the b-tree file structure—the most efficient data access method known. With Btrieve your applications run* fast.

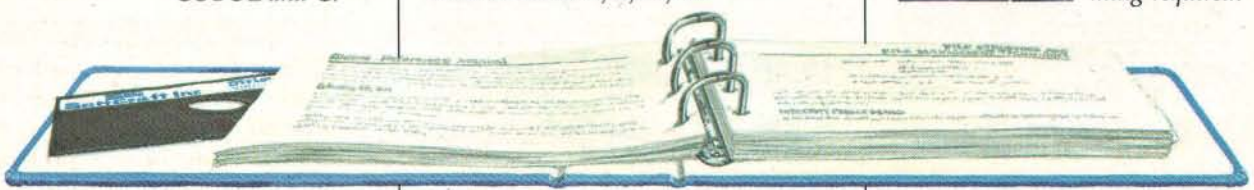
Database queries, report writing. *Add Xtrieve™ to your Btrieve applications for a fully-relational DBMS. Xtrieve's menu-driven interface lets you look up information easily—without programming. Add our report writer option to produce custom reports and forms.*



Interfaces to C, BASIC, Pascal, COBOL. *Don't waste time learning a proprietary language! With Btrieve you can use the language you know best—and immediately begin programming the right way. Over 15 language interfaces are available.*



Fault tolerant. *Btrieve insures against database disasters. Two levels of fault tolerance guarantee data integrity during accidents or power failures—no extra programming required.*



Inquiry 278

in it, I am no longer supporting it. I have recently finished the writing and testing of ATOMFT, versions 1.10 and 2.10.

Version 1.10 was written to satisfy the request made by Jet Propulsion Laboratory for the capability of solving problems with any number of user-defined functions. The FT in ATOMFT stands for function. Also, ATOMFT is written in FORTRAN 77. It is bug-free! And it is perfectly portable. The same code can be used for all micros, as well as all mainframes.

Version 2.10 was written to solve control problems, otherwise called DAEs (differential algebraic equations).

The charge is $200 for the source code of version 1.10; $30 for the object code of version 1.10 (for use with Microsoft FORTRAN 3.30 or later); $1000 for version 2.10 source code.

Y. F. Chang
Claremont. CA

Call for Papers

Computer Professionals for Social Responsibility will be sponsoring a symposium, "Directions and Implications of Advanced Computing," in Washington, D.C., in July.

The adoption of current computing technology, and of technologies that seem likely to emerge in the near future, will have a significant impact on the military, on financial affairs, on privacy and civil liberty, on the medical and educational professions, and on commerce and business.

The aim of this symposium is to consider these influences in a social and political context as well as a technical one. The social implications of current computing technology, particularly in artificial intelligence, are such that attempts to separate science and policy are unrealistic. We therefore solicit papers that directly access the wide range of ethical and moral questions that lie at the junction of science and policy.

We request papers that address, but are not limited to, such topics as: research funding, computing in a democratic society, defense applications and computers in the public interest.

For more information, call Jonathan Jacky at (206) 548-4117 or Doug Schuler at (206) 783-0145.

Doug Schuler
Computer Professionals for Social Responsibility
Box 85481
Seattle, WA 98105

Call for Help

Help! I'm an absent-minded professor who's in trouble. I am trying to locate a machine-language simulator for the Apple II family, which I recall having seen about two years ago. The particular simulator I have in mind breaks each operation into its micro-operations, displaying them on the screen as the graphics demonstrate their execution.

My only problem is that I've forgotten the name of this program! Can anyone help me find it? Any leads will be appreciated. Please call (414) 652-3996 if you have any suggestions.

Charlotte J. Chell
Carthage College
Kenosha, WI

ZBasic Defended

I have used ZBasic for almost a year on a CP/M system. I could not let the comments from Edward L. Tottle ("Not Your Basic BASIC," November 1986) go unanswered.

First, while ZBasic has some differences from MBASIC, it is certainly no worse than going from, say, MBASIC to Color Computer BASIC (to say nothing of CBASIC). In addition, the differences usually favor ZBasic. Having used several varieties of BASIC over the years, I have

continued

dBASE Users:
DON'T CHANGE A THING!
FoxBASE+ does it all.

Ask The Reviewers . . .

"FoxBASE+ Maintains Stunning Speed, Adds dBASE III PLUS Compatibility. . . FoxBASE+ zooms to the head of the dBASE-compatible class."
—Glenn Hart, PC Magazine, December 9, 1986.

"FoxBASE+ is the fastest and easiest-to-use dBASE product on the market."
—George Goley, Data Based Advisor, November, 1986.

"FoxBASE+ BLOWS dBASE III PLUS AWAY!! . . . ran every dBASE program I had with NO changes whatsoever!"
—James Gates, Atlanta Data Base Users Society Newsletter, November, 1986.

WHAT FoxBASE+ CAN DO FOR YOU

- YOU DON'T CHANGE YOUR PROGRAMS. FoxBASE+ runs **your** dBASE III PLUS applications more than 6 times faster *without changing one line.*
- Forget about conversion woes. You don't have to do a thing to your databases or other dBASE files to use FoxBASE+.
- You don't have to bend over backward to use FoxBase+ . It's used in *exactly* the same, familiar, user-friendly way you use dBASE III PLUS. As a dBASE user you already know how to use FoxBASE+.
- FoxBASE+ lets you keep using the best parts of dBASE III PLUS. It's a **fully interactive** compiler so you can still use great features like EDIT, BROWSE, etc.
- FoxBASE+ doesn't make you spend hours compiling and linking your programs like some "speed-up" products.
- FoxBASE+ runs your compiled programs twice as fast as Clipper and 3 times faster than Quicksilver.
- Best of all, Single-user MS-DOS FoxBASE+ costs just $395 and Multi-user FoxBASE+ $595 with a **money-back guarantee.** *Royalty-free runtime also available.*

If you like dBASE III PLUS, YOU'LL LOVE FoxBASE+ !!

So call (419) 874-0162 now for the details. After all . . .

Nothing Runs Like a Fox.

FoxBASE™

FoxBASE+ is a trademark of Fox Software. dBASE III PLUS is a trademark of Ashton-Tate. Clipper is a trademark of Nantucket. Quicksilver is a trademark of WordTech Systems Inc. MS is a registered trademark of Microsoft Corporation.

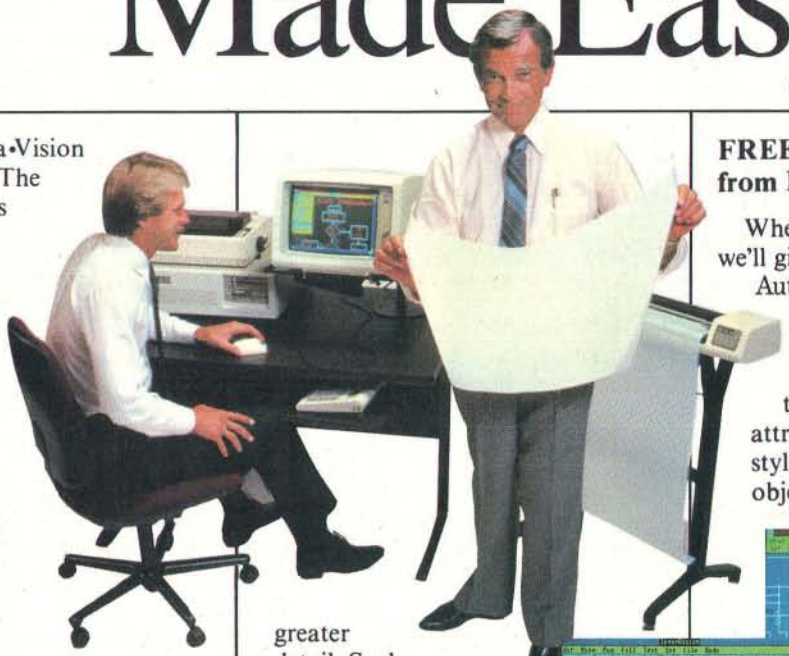
Fox Software
27475 Holiday Lane, Perrysburg, OH 43551
(419) 874-0162 Telex 6503040827

Inquiry 114

New! In•a•Vision is Compatible with AutoCAD

Limited Offer
FREE AutoCAD Translator

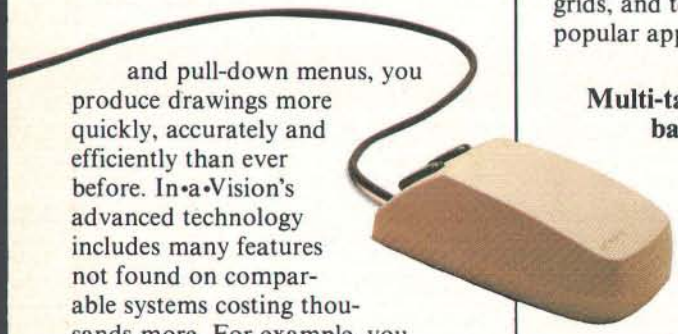
Complex Drawing Made Easy



We created In•a•Vision just for you. The engineer who needs more productive drafting support. The designer who needs versatility for alternate ideas or quick revisions. The architect who needs to manage a variety of working drawings. And the businessman who needs first-class presentation materials as well as detailed flow charts and organization charts.

Point. Click. Draw.

Now all you do to create complex technical drawings, systems designs, blueprints, diagrams, illustrations, and proposals is point, click and draw. With In•a•Vision's mouse support, windowing, icons, and pull-down menus, you produce drawings more quickly, accurately and efficiently than ever before. In•a•Vision's advanced technology includes many features not found on comparable systems costing thousands more. For example, you can pan around in a user-definable drawing space up to 68″ x 68″ and zoom in on specific areas for greater detail. Scale, rotate and dimension symbols, fill an area with your choices of predefined colors and patterns, as well as draw lines with multiple styles and widths. Other features include overlays, predefined and user-definable page sizes, rulers, grids, and templates to speed popular applications.

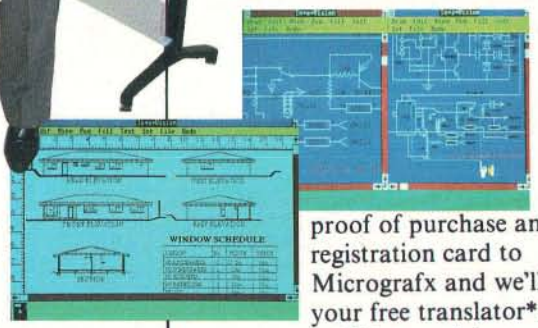


Multi-tasking in a PC-based CAD system.

In•a•Vision uses multi-tasking to enable you to continue drawing while printing hard copies *or* edit multiple drawings simultaneously.

FREE AutoCAD Translator from MICROGRAFX!

When you purchase In•a•Vision we'll give you a free copy of our new AutoCAD™ translator. The Micrografx AutoCAD TRANSLATOR (retail value $100) bi-directionally transforms all drawing attributes including colors, line styles, overlays, fonts, views and object hierarchy. (Send proof of purchase and your registration card to Micrografx and we'll return your free translator*.)



We're confident you'll agree — In•a•Vision will make your complex drawing tasks simple and make you more productive. Satisfaction guaranteed.



TO ORDER CALL: 800-272-3729

Demo disk** or brochure available to qualified customers. In Texas or for customer support, call (214) 234-1769.

MICROGRAFX, Inc., 1820 North Greenville Avenue, Richardson, Texas 75081.

Inquiry 188

(Most popular graphics cards, plotters, and printers supported.)
Microsoft Windows-compatible. Call for specific operating environment requirements.
*Offer good only on purchases after January 1, 1987
**Demo requires MS Windows. Full demonstration system for users without Windows available for $49.00.

MICROGRAFX™
The Picture of Success.

AutoCAD is a trademark of Autodesk INC.
In-a-Vision, Micrografx AutoCAD TRANSLATOR, and MICROGRAFX are trademarks of MICROGRAFX, Inc.
Microsoft is a trademark of Microsoft, Inc.

yet to see two totally compatible versions. As for Microsoft's "Gee, I didn't know you had to put a space there" solution to the embedded-word problem, I would question whether it is any better, especially as it is all but undocumented in any information I have seen on MBASIC.

Second, if you want a forced floating-point divide in ZBasic, use 1\3 instead of 1/3 and you will get the correct answer. This is clearly stated in the ZBasic reference manual.

Third, as far as digits of precision, you can only set this on the configuration option. As a standard, the precision is 6 digits for single precision and 16 digits for double precision, which is the same as MBASIC. In this or any other type of BASIC, special configuration information should be put in REM statements.

Now, let us review some features of ZBasic that reader Tottle dismisses.

One very nice feature is being able to use labels or line numbers for branching. This makes programs much more understandable (i.e., GOTO "main program start" is much more understandable than GOTO 1000).

ZBasic allows you to write structured programs easily while still allowing you to be flexible. Commands like LONG IF, LONG FN, and the three types of looping allow a program to be written to allow for easy understanding when improving or maintaining programs. ZBasic also allows for libraries to be built of common commands and subroutines, and added from disk for easy programming.

Another feature that speeds up program debugging is the fact that programs can be run in an interpreted mode. You can check for syntax errors and the like quickly, and repair them using the built-in editor. After debugging, you can compile to disk with one command and, if necessary, increase your memory to allow for large arrays. I have used up to 32K bytes, but more is possible. (And while running CP/M. Try that with MBASIC.)

ZBasic is also available for an Apple IIc, IIe, and Macintosh, TRS-80 I, III, and 4, IBM PC (and compatibles), and CP/M systems. With that many systems supported, it might not totally eliminate rewriting code when going from one machine to another, but it will simplify it.

Machine-language support in ZBasic is very good. With the MACHLG statement, it is possible to put machine-language routines in your BASIC code and to use ZBasic variable names in those routines. This allows for special routines to be written and installed in your programs easily.

Zedcor gives good support for ZBasic. In fact, their support by phone and mail is better than some computer dealers have given in person.

While ZBasic is not perfect, if you are looking for a BASIC that can either compile or interpret, and is fast in either mode, ZBasic is a good choice. It is also much cheaper than Microsoft's BASIC interpreter and compiler.

David Postler
Elgin, IL

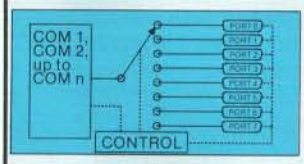
FIXES

Photographic Switcheroo

In the December 1986 What's New section, we mistakenly ran a photo of a graphic produced with the Stella Business Graphics program where we should have shown an image generated by VCN Concorde 1.01 (see page 30). Two pages later, we ran the VCN Concorde graphic where the Stella image belonged. Our apologies to all, and particularly to Stella Systems and Visual Communications Network. ■

DOS Compatible . . .

SOFTWARE CONTROLLED RS232C SWITCH





PCSS-8

- Select one of 8 RS232C devices from the keyboard
- Use multiple serial devices **without modifying application software**
- May be used for real-time event driven applications
- Works like an eight position A-B switch

The Personal PAL® Developer's Success-kit



MODEL 7344 DEVELOPMENT SYSTEM

- Add PAL® design capability to your IBM PC
- Supports development, functional test, and programming of 20 and 24 pin devices
- PALXASM Compiler included
- Program devices from existing JEDEC files
- A complete solution—programmer, cable, and software

Also available — Personal EPROM systems, OEM programmers, and production programmers/duplicators

DRAWER 1346
BAY ST. LOUIS, MS 39520

GTEK, INC.

ORDER TOLL FREE
1-800-255-GTEK (4835)

GTEK, PALXASM, MS-DOS, PC-DOS, & PAL are registered trademarks

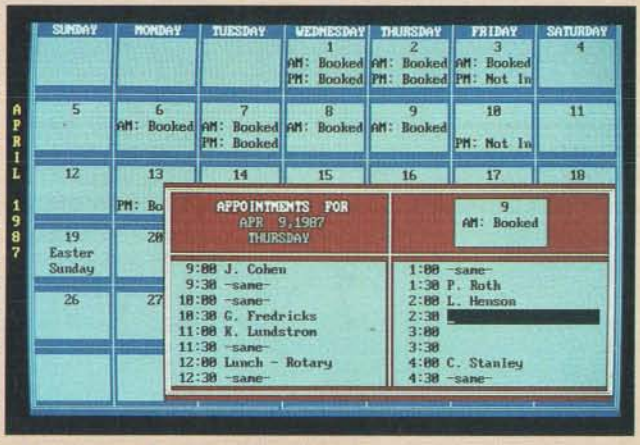
Inquiry 128

BOB STANTON HAD A GREAT IDEA. AN HOUR LATER HE WAS TESTING IT.

Appointments. Everybody takes them — dentists, auto-body shops, dance instructors. And lots of computer applications need appointment screens.

Bob thought that a calendar made a terrific graphic metaphor for taking appointments. Simply use the arrow keys to pick an open date, then press the Enter key, and up pops an appointment window.

Lucky for Bob, he's a CLARION programmer, one of a fast growing cadre of super-productive application developers.





With CLARION's Screener utility, he painted a white calendar on a black background. Then he drew a white-on-blue track around the page and between the days. He typed in the days of the week — and *voila!* — a calendar!

CLARION knows that a PC monitor is refreshed from memory, so it treats a screen layout like a group of variables. Just move data to a screen variable, and it shows up on the monitor.

Bob set up dimensioned screen variables for the days of the month and a screen pointer for selecting a date, and he was done. Then Screener generated the code .

Then Bob drew the appointments window, built an appointment file, filled in the connecting code and tested it — ONE HOUR AFTER HE STARTED!

Testing was a breeze. Screener doesn't just write code, it compiles your source, displays a screen, gets the changes, then replaces the old code in your program.

So here are Bob's appointment screens. You can see the source listing to the right. We marked all the code Screener wrote for him.



WHY CLARION?

Why are application developers everywhere changing to CLARION?

Because CLARION gives you all the tools you need: a coupled compiler and editor; screen, report, and help generators; an import/export utility; a sort/backup/restore utility; a formatted file dump; a DOS shell — and much more.

Because with CLARION 's comprehensive data management routines, records can be locked and files shared on Novell®, 3COM®, IBM® PC Net & Token Ring, Multi Link®, and most other networks.

Because CLARION is *not* hardware locked or copy protected. Run-time systems are *free* and soon you will be able to translate CLARION into native machine code (.EXEs).

And best yet, the price of CLARION v1.1 is just $395 plus shipping and handling.

You'll need an IBM PC or true compatible with 320KB of memory and a hard disk drive. CLARION v1.1 also comes with a 30-day money back guarantee.

So call now and order CLARION v1.1. or ask for our detailed 16-page color brochure and reprints of major reviews.

800/354-5444

CLARION®
from BARRINGTON SYSTEMS, INC.

150 EAST SAMPLE ROAD **POMPANO BEACH, FLORIDA 33064** **305/785-4555**

Copyright 1986 Barrington Systems, Inc. CLARION is a registered trademark of Barrington Systems, Inc. IBM is a registered trademark of International Business Machines Corporation Novell is a registered trademark of Novell, Inc. 3COM is a registered trademark of 3COM Corporation Multi Link is a registered trademark of Software Link, Inc. Dept. A9

Tech Personal Comput

Tech PC Twin Multiuser Starting From $1699

Tech PC/88® base unit with 640K, and two 360K disk drives.

Two high resolution monitors, two selectric style keyboards, 50 feet of shielded cable to separate the two stations.

System supports up to six printers.

Full software support with multi-level file, security, electronic message facility to send and receive messages between users, password logon system, and system operator command level.

System supports all popular software such as Wordstar™, dBaseIII™, Lotus 123™, Multimate™, etc.

Tech PC Triad Multiuser Starting From $2599

Tech PC/88® base unit with 640K, and two 360K disk drives.

Separate Intel 80188 microprocessor running at 8 MHz and 512K for each terminal.

Three high resolution monitors, three Selectric™ style keyboards, 50 feet of shielded cable to separate the three stations.

System expandable to 32 workstations.

System supports up to six printers.

Full support for multitasking multiterminal use with print spooling for multiple printers, background monitoring of the system, dial up bulletin board support, passwork protection, and file/record locking supporting PC Network™ protocol.

System supports all popular software such as Wordstar™, dBaseIII™, Lotus 123™, Multimate™, etc.

Tech PC Quad Multiuser Starting From $4499

Tech Turbo PC/286® base unit in portable or desktop configuration with 256K, multiple serial ports, three Tech PC terminals, connecting cables, and networking software.

Four users expandable to nine users over dumb terminals or PC's with terminal emulation software.

Capacity for up to 16 printers at remote sites with up to 6 local printers attached to the main unit.

Each user can access 512K of RAM with memory expansion boards.

Full support for multitasking multiterminal use with print spooling for central or terminal printing, background monitoring of the system, dial up bulletin board support, password protection, and File/Record locking using PC Network™ protocol.

System supports all popular software such as Wordstar™, dBaseIII™, Lotus 123™, Multimate™, etc.

Tech PC Turbo Quad Multiuser Starting From $5999

Tech PC/88® base unit in desktop configuration with 640K, multiple serial ports, three Tech PC terminals, connecting cables, and networking software.

Separate NEC™ V20 8088 Intel™ compatible 8 MHz CPU and up to 1 MB RAM for each terminal on the system.

Two fully functional serial ports per terminal.

Four users expandable to 32 users over dumb terminals or PC's with terminal emulation software.

Capacity for unlimited number of local printers.

Full support for multitasking multiterminal use with print spooling for multiple printers, background monitoring of the system, dial up bulletin board support, password protection, and File/Record locking supporting PC Network™ protocol.

System supports all popular software such as Wordstar™, dBaseIII™, Lotus 123™, Multimate™, etc.



XT, AT and PC-DOS are registered trademarks of International Business Machines Corporation. MS-DOS and Xenix are registered trademarks of Microsoft

ers Inc.

From the Leader in Quality, Performance, and State of the Art Computer System Engineering...

Introducing...A New Profile Desktop Series of IBM XT® Compatibles.

The PC II Series of IBM XT compatible computers are designed to provide enhanced capacity and processing power to XT type computer systems. Combined with a 12 inch, 800 by 400 line amber monochrome monitor or a 14 inch, 1280 by 800 black and white monochrome monitor you've got state of the art staring straight back at you. If 4.77 MHz 8088 power isn't fast enough for you...Try the Tech-Turbo PC/88 II® with its 4.77 to 8 MHz 8088 or optional V20 CPU. The Tech-Turbo PC/88 II gives you the strongest most powerful 8088 unit performance available from anyone, anywhere... Need some heavy duty memory, order the unit with 2 to 8 megabytes of expanded memory... Your choice. How about hard disks... We've got those too.

At Tech PC we're out to capture your corporate microcomputer business. No one matches our diverse line of high performance products, or our comprehensive system of support, warranty, and third party maintenance service options through Momentum Service Corporation.

Call or write Tech Personal Computers for more information on our full line of Desktop, Portable, Multi-User Computer Systems and Computer System Accessories.

Tech-Turbo PC/88 II®
$629.00 Gives You:
19 Inch Desktop Sized Sturdy Case
4.77 to 8 MHz 8088 CPU
8087 Math Co-Processor Socket
640K RAM
Floppy Disk Controller
One, 360K Floppy Drive
Eight 8 Bit Expansion Slots
150 Watt DC Fan Power Supply
AT Style Soft-Touch Keyboard
One Year Warranty
Third Party Maintenance Options

$829.00 Gives You:
Tech PC/88 II Turbo System with Monochrome Monitor, and Hercules® Compatible Mono/Graphics Card.

$1279.00 Gives You:
Tech-Turbo PC/88 II System with Monochrome Monitor, Hercules® Compatible Mono/Graphics Card, and 20 MB Hard Disk.

Complete MS-DOS, PC-DOS, Xenex Compatibility

Runs Lotus 123,® dBase III,® Framework,® and All Other XT® Software.

Tech PC/88 II®
$529.00 Gives You:
19 Inch Desktop Sized Sturdy Case
4.77 MHz 8088 CPU
8087 Math Co-Processor Socket
640K RAM
Floppy Disk Controller
One, 360K Floppy Drive
Eight 8 Bit Expansion Slots
150 Watt DC Fan Power Supply
AT Style Soft-Touch Keyboard
One Year Warranty
Third Party Maintenance Options

$729.00 Gives You:
Tech PC/88 II System with Monochrome Monitor, and Hercules® Compatible Mono/Graphics Card.

$1179.00 Gives You:
Tech PC/88 II System with Monochrome Monitor, Hercules® Compatible Mono/Graphics Card, and 20 MB Hard Disk.

THIRD PARTY MAINTENANCE OPTION AVAILABLE THROUGH MOMENTUM SERVICE CORPORATION



TECH PC
(714) 385-1711
1911 Betmor Lane, Anaheim, California 92805
Telex 272006 Answer Back - TECH FAX: 7143851523

Inquiry 302 for End-Users.
Inquiry 303 for DEALERS ONLY.

Tech PC/88 II, Tech-Turbo PC/88 II are registered trademarks of Tech Personal Computers, Inc.

Successful Teams.

Corporation. Lotus 1-2-3 is a registered trademark of Lotus Development Corporation. dBase III and Framework are registered trademarks of Ashton-Tate.

MULTI USER PC SYSTEM WITH ADC'S PC-SLAVE



Just plug ADC's PC-Slave Board into your PC expansion slot, a connecting RS-232 cable, a low cost ASCII terminal or a PC look-alike terminal such as ADC-PC terminal and you now have another workstation on your PC(AT). As many as 31 low cost workstations may be added to your PC(AT). Share a common data base without loss of speed or efficiency since each PC-Slave board has its own CPU(8088), 512-1MB of memory dedicated to each user. ADC provides additional software (RTNX,ATNX) which support file & record locking and print spooling. ADC's PC-Slave provides the best multi-user PC system available today.

In U.S.
5432 Production Drive
Huntington Beach, CA 92649
(714) 891-4004 • (800) 251-1801
Telex 183210 ADVANCED HTBH

ADC
ADVANCED DIGITAL CORPORATION

In Europe
Advanced Digital (U.K) Ltd.
21 Newman Street
London W1-United Kingdom
(01) 323-1120

Create PostScript-based Illustrations with the Mac

The Adobe Illustrator enables you to create your own illustrations or trace scanned images from a photograph, logotype, blueprint, rough sketch, or MacPaint image. With the Adobe Illustrator's pen, you trace the shapes, then fill in all or part of the image, adjust lines to any weight, and add captions. You can also combine two images into one, rotate part or all of a drawing to any angle, and scale, skew, and manipulate a drawing. You can move or change objects within the drawing, zoom in on details, and preview the drawing before printing.

You can print your documents on any PostScript-equipped printer, Adobe reports, resulting in a resolution from 300 dots per inch up to 2540 dots per inch.
Price: $495.
Contact: Adobe Systems Inc., 1870 Embarcadero Rd., Palo Alto, CA 94303, (415) 852-0271.
Inquiry 576.

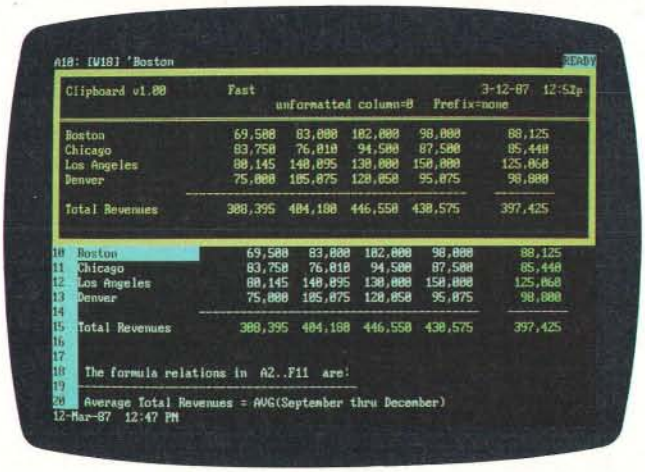
Atari's PC Clone

The Atari PC is the company's first move into the world of IBM clones. The low-cost system is based around an 8086 microprocessor running at either 4.77 or 8 MHz. There's also a socket on the motherboard for adding an 8087 math coprocessor.

The system comes with a single 5¼-inch floppy disk drive and has provisions for an external 5¼- or 3½-inch drive. It comes with 512K bytes of RAM, and memory can be expanded to 640K bytes on the motherboard. On the rear panel, there are serial, parallel, video, and Atari ST-style disk ports. There's also a mouse and a mouse port based on Microsoft's Inport chip. There's no room in the box for adding circuit cards, but the company says it will introduce an external expansion box later.

For graphics, the Atari machine provides Hercules, IBM monochrome, CGA, and EGA capabilities. An optional monochrome monitor supports all the display modes using gray scales to represent color.

The Atari PC system unit measures 22 inches square by 2 inches high and comes with an "XT-style" keyboard. The company claims that it's 100 percent compatible with software designed for the IBM PC.
Price: $699 with monochrome monitor and EGA capability; $499 less monitor and EGA capability.
Contact: Atari, 1196 Borregas, Sunnyvale, CA 94088, (408) 745-2000.
Inquiry 577.



Clipboard, one of Metro's pop-up application-management tools.

Pop-Up Desktop Accessories with Metro

Metro, a memory-resident desktop manager from Lotus Development Corporation, can be used as a companion to 1-2-3, Symphony, Manuscript, and other Lotus programs or can be used alone.

The program's pop-up application-management tools include a text editor, a DOS file manager, a clipboard, an HP-12C–style financial calculator, a notepad, a phone book, a list manager, and a macro generator. You can configure your system's memory by loading in the application tools that you need. The text editor offers word processing capabilities in a familiar Lotus interface and enables you to create and edit files without leaving 1-2-3, Symphony, or other application programs you're working with. The clipboard lets you cut and paste data between Metro and other Lotus application programs, and the DOS file manager formats disks and creates subdirectories also without leaving the main application.

Metro's macro generator features a command language, which includes IF. . .THEN branching with variable definitions and GOSUB routines. A learn mode records a series of keystrokes and commands that you can execute with a single key. The generator also enables you to create your own menus, templates, and text screens.

The program uses the same TSR (terminate but stay resident) kernel used by the Lotus Express communications program. Metro is based on Lotus's adaptation of Spotlight, a TSR-based program created by Software Arts, a recent Lotus acquisition. In creating Metro, Lotus added to Spotlight the memory configuration capability, text editor, list manager, DOS filer, clipboard, and macro generator. Spotlight users can upgrade to Metro for $40, Lotus reports.

To run Metro, you'll need an IBM PC, XT, AT, or compatible with at least 80K bytes of RAM available for the RAM-resident portion of the program. MS-DOS or PC-DOS 2.0 or higher is necessary, along with two floppy disk drives. (Lotus recommends a hard disk drive for optimal performance.)
Price: $85.
Contact: Lotus Development Corp., 55 Cambridge Parkway, Cambridge, MA 02142, (617) 577-8500.
Inquiry 578.

Four New 80386 Products

Intel Corporation has introduced four new products for the 80386 line.

The 80386/20 is a 20-MHz version of the 80386. It's

continued

available in production quantities immediately.

The 80387 numeric coprocessor, which was first announced in October 1985, is now available, also in production quantities.

For system designers, the 82380 DMA controller is a 32-bit, 8-channel, 32-megabyte-per-second controller that includes DMA, DRAM control, interrupt controller, program interval timers, and other control logic.

Finally, the 82385 cache controller has features such as bus watching and posted writethrough. It will be available in production quantities by the end of 1987.
Prices: $599 for the 80386/20, quantity of 100; $350 (80387, quantity 1000); $145 (82380, quantity 1000). 82385 pricing not yet available.
Contact: Intel Corporation, 3065 Bowers Ave., Santa Clara, CA 95051, (408) 987-8080.
Inquiry 579.

HP's Symbolic Math Calculator

Coinciding with the fifteenth anniversary of the HP-35, the world's first handheld scientific calculator, Hewlett-Packard has introduced the HP-28C, which the company claims is the first calculator capable of doing symbolic mathematics. With a 4-line by 23-character liquid-crystal display, 128K bytes of ROM, and separate alpha and numeric keyboards, you can view, edit, and use complex numbers, matrices, vectors, lists, algebraic expressions, and other data types. A built-in operating system lets you mix direct entry of algebraic expressions with reverse Polish notation.

Equations can be entered and stored in whatever terms you choose with the HP-28C's equation-solver capability. The unit then solves an equation for any unknown variable anywhere in the equation.



The HP-28C calculator performs symbolic mathematics.

The display can graphically depict any single-valued functions and plot statistical data. Once an expression is plotted in the display, you can locate an appropriate root, press a key to record the coordinates, then use the equation solver to calculate the root with 12-digit accuracy.

The HP-28C weighs 8 ounces and measures 7½ inches by 6¼ inches by ½ inch when open. An optional compact printer is available that can be used to record keystrokes, show stored data, or selectively print the display contents. It communicates with the HP-28C via an infrared beam.
Price: $235; printer, $135.
Contact: Hewlett-Packard, 1820 Embarcadero Rd., Palo Alto, CA 94303, (800) 367-4772.
Inquiry 580.

Xerox's Hardware Spelling Checker

Developed by Xerox's Palo Alto Research Center, PC Type Right is a hardware spelling checker that plugs in between the keyboard and system unit of any IBM PC- or AT-compatible computer system, thus taking up neither disk nor RAM space. The spelling checker instantly checks words as they're entered against its built-in dictionary and beeps at you if it detects an error. The volume and tone of the beep are adjustable, and you can also incorporate a 1200-word personal dictionary.

Xerox claims that PC Type Right recognizes far more words than competing spelling checkers, including proper names, place names, and technical terms. It will also let you know if you type two identical words in a row (e.g., the the).
Price: $199.95.
Contact: Xerox Corporation, Xerox Square 006, Rochester, NY 14644, (716) 423-5078.
Inquiry 581.

Split-Screen Text Editor for Under $30

The Mix Editor was designed to work with the Mix C Compiler, although it features automatic indenting for languages such as C or Pascal, automatic line numbering for BASIC, and fill and justify for English.

Several of the editor's features simplify the development of source code in high-level languages. For instance, you can move text between windows with the screen split horizontally or vertically. And over 100 predefined commands are included, on which you can build macros.

The program runs on the IBM PC and compatibles with MS-DOS or PC-DOS 2.0 and higher and on CP/M-80 systems. The MS-DOS version has a macro for compiling directly from memory, and if the program discovers an error, it places the cursor on it and displays an error message.

Mix Software reports that the editor is designed for novice programmers in that it generates functional programs that are larger but slower than those generated by professional C compilers.
Price: $29.95; the Mix C Compiler sells for $39.95.
Contact: Mix Software Inc., 2116 East Arapaho, Suite 363, Richardson, TX 75081, (214) 783-6001.
Inquiry 582.

Mailman for the 386

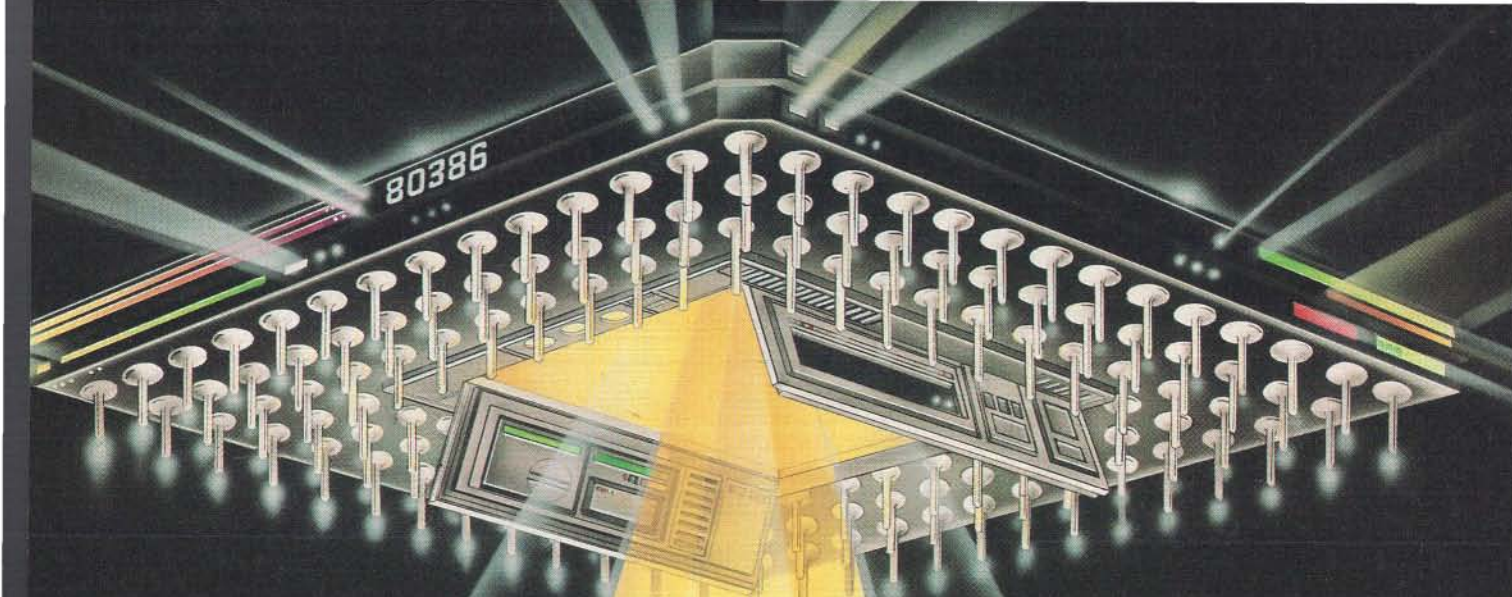
RPM Systems has announced an electronic mail system for 80386-based systems. The program, called Mailman, runs on the IBM PC and compatibles while the heart of the system resides on an 80386 PC.

The interface is a set of windows that enable you to see where you are in the system at all times. A built-in word processor lets you create mail messages. Other functions of the system include reading new and old mail, sending, checking the user list, and withdrawing a mail message before it is sent.

Mailman is PC-Net LAN-compatible, and you can use it as a node on a PC-Net LAN or attach it to other LANs through an RPM interface.

You'll need an 80386 system with UNIX V or XENIX V and an IBM PC or compatible running MS-DOS or PC-DOS 2.0 or higher.
Price: $2000.
Contact: RPM Systems, 13 Corporate Plaza, Newport Beach, CA 92660, (714) 720-0226.
Inquiry 583.

continued



Imagine the speed and power of a $100,000 minicomputer in a desktop PC costing under $7,000. Now imagine all that power going to waste because the operating system you chose was never meant to take advantage of a computer this powerful. It will take more than just a "window environment" or an outdated operating system to unlock the 80386.

It will take PC-MOS/386™.

The First 80386 Operating System. Specifically designed for the 80386 computer, PC-MOS/386™ opens doors. Doors to more memory and multi-tasking. Doors to thousands of DOS programs as well as upcoming 80386-specific software. It's the *gateway* to the latest technology..., and your networking future.

Memory Management Without Boards. PC-MOS exploits the memory management capabilities built into the 80386. So, up to four GIGABYTES of memory are accessible to multiple users and to future 80386-specific applications requiring megabytes of memory.

Multi-Tasking, Multi-User Support for One, Five or 25 Users. PC-MOS/386™ allows up to 25 inexpensive terminals to be driven by a single 80386 machine. So the features of the 80386 can be utilized at every terminal. And it comes in three versions so you can upgrade your system as your company grows...without having to learn new commands or install new hardware.

UP TO 25 USERS.

MADE FOR THE 80386.

RUNS DOS PROGRAMS.

MULTI-TASKING



Software Support for Thousands of DOS Programs. Although PC-MOS/386™ totally replaces DOS, it doesn't make you replace your favorite DOS programs. So you can run programs like Lotus 1-2-3, WordStar, dBASE III, and WordPerfect on the 80386. Best of all, it uses familiar commands like DIR and COPY–so you'll feel comfortable with our system.

The Gateway to Endless Features. Distinctive characteristics like file/system security, remote access, file/record locking, and built-in color graphics support for EACH user set PC-MOS/386™ apart from all previous operating systems.

Open the Doors to Your Future TODAY! Call The Software Link TODAY for more information and the authorized dealer nearest you. PC-MOS/386™ comes in single, five & 25-user versions starting at $195.

THE SOFTWARE LINK, INC.

Developers of LANLink™ & MultiLink® Advanced

8601 Dunwoody Place, Suite 632
Atlanta, GA 30338 Telex 4996147 SWLINK

CALL: 800/451-LINK

In Georgia: 404/998-0019
Dealer/OEM Inquiries Invited
Dealers: 404/998-0700 OEMs: 404/641-8554

THE SOFTWARE LINK, INC./CANADA
CALL: 416/477-5480

More Than Just Windows, We've Opened Doors.

TRADEMARK ACKNOWLEDGEMENTS: MultiLink® is a registered trademark of The Software Link, Inc. PC-MOS/386™ MultiLink® Advanced, and LANLink™ are trademarks of The Software Link, Inc. Lotus 1-2-3, WordStar, dBASE III, & WordPerfect are trademarks of Lotus Development Corp., MicroPro, Ashton-Tate, & WordPerfect Corp., respectively. Prices and technical specifications subject to change.

Inquiry 286 for End-Users. Inquiry 287 for DEALERS ONLY.

MicroPro Announces New Version of WordStar

WordStar Professional 4.0 has 129 new features, which include an on-line 220,000-word thesaurus, line and box drawing capability, programmable macros and function keys, and file locking for local area network support. A local area network file-server version and a LAN node version are available as well.

Also available with WordStar Professional is a 6000-word legal, 68,000-word medical, and 8500-word financial dictionary that you can use with the 87,000-word dictionary for CorrectStar, which is included. The specialized dictionaries sell for $25 each.

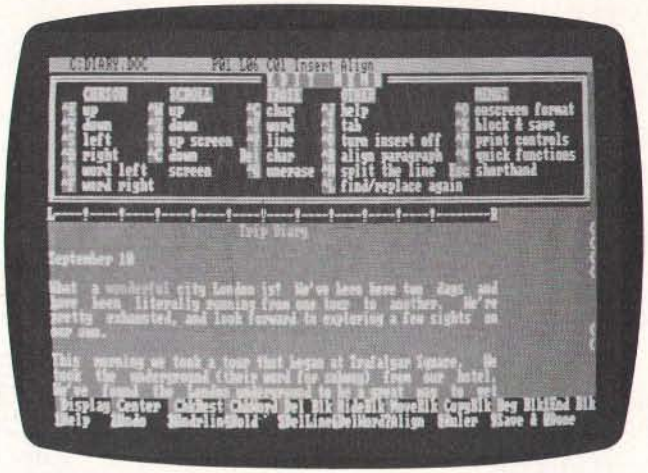
MicroPro reports that you can install the program to be completely or partially RAM-resident.

The program runs on the IBM PC and compatibles with MS-DOS or PC-DOS 2.0 or higher with at least 256K bytes of RAM (you'll need 320K to use the thesaurus). The LAN versions are available for Novell NetWare, 3Com Ethernet, and IBM PCNet, and the program supports the IBM Color Graphics Adapter card or monochrome adapter.

Price: $495 for the single-user version; $595 for the LAN file-server version; $150 for the LAN node documentation and license registration forms.

Contact: MicroPro International, 33 San Pablo Ave., San Rafael, CA 94903, (415) 499-1200.

Inquiry 584.



MicroPro's WordStar Professional 4.0.

High-Speed 386 Board for 286 Machines

Orchid Technology has rolled out Jet 386, its entry into the 80386 add-in board market. Running at 16 MHz, the Jet has a socket into which you plug the 80286 processor that you remove when you install the board. You can then switch between the 286 and 386 via a toggle switch on the rear of the board.

Jet 386 supports both 80287 and 80387 arithmetic coprocessor chips and has 64K bytes of cache memory. Orchid claims the board is 100 percent compatible with AT-compatible software and add-ins.

Price: $1499

Contact: Orchid Technology, 47790 Westinghouse Dr., Fremont, CA 94539, (415) 490-8586.

Inquiry 585.

GCLISP for the Compaq Deskpro 386

Gold Hill Computers has announced the Golden Common LISP 386 Developer for the Compaq Deskpro 386. You can integrate C programs with artificial intelligence applications with GCLISP 386, according to Gold Hill. The program features a large memory interpreter and compiler, an on-line help system, and an enhanced editor that has over 150 commands, uses EMACS key-chord bindings, and gives you the option of defining your own key-chord bindings. Also supported are lexical scoping, packages, and transcendental functions, which enable you to port Common LISP programs to personal computers.

Price: $1195.

Contact: Gold Hill Computers, 163 Harvard St., Cambridge, MA 02139, (617) 492-2071; in MA, (800) 242-5477.

Inquiry 586.

1200-bps Security Modem

Besides being a Bell 212A-compatible modem that uses the Hayes AT command set, the GTX-100R from A-O Electronics can be used to turn computers or other equipment on and off from a remote location. The modem incorporates dial-back verification and password security so that only authorized users can get through the modem to power up equipment. After access is attempted, the GTX-100R hangs up and searches for the calling number in an "authorized directory" stored in CMOS RAM. If a number is found, it dials back, re-establishes contact, and asks for a password. As a further security measure, after several unsuccessful password entry attempts, the GTX-100R removes the telephone number from its authorized list.

The remote-on feature can also be disabled, allowing the GTX-100R to function as a normal modem.

Price: $895.

Contact: A-O Electronics, 2137 Flintstone Dr., Tucker, GA 30084, (404) 491-8044.

Inquiry 587.

A Color Dot-Matrix Printer/Plotter

Honeywell Information Systems Italia has rolled out the 4/66P, an 18-pin color dot-matrix printer with plotter capability that is compatible with the Hewlett-Packard 7475A plotter and the Hewlett-Packard graphics language.

Used as a plotter, the 4/66P has three choices of resolution: 144 by 72 dots per inch; 144 by 144 dpi, and 288 by 144 dpi (all at 13.3 inches per second). The maximum plotting area is 15.6 by 19.6 inches.

Used as a printer, the 4/66P is compatible with Epson and IBM control codes. It prints in up to seven colors at 480 cps for draft quality, 180 cps for near letter quality; and 75 cps for letter quality. The unit will print on paper up to 17 by 24 inches. You can also switch between cut-sheet and continuous-form paper without having to remove the continuous paper.

Price: $2995.

Contact: Honeywell Information Systems Italia, 390 Fourth St., San Francisco, CA 94107, (415) 974-6116.

Inquiry 588.

Toshiba Enhances Top-of-Line Printer

Toshiba's P351 Model 2 is an enhanced version of the company's top-of-the-line 24-pin dot-matrix printer. New features on the Model 2 include the ability to select print quality, font, and pitch from the front panel. The unit's DIP switches are located directly beneath the front cover for easy access. And to meet government and

continued



Book #76737-6
Pub. pr. $48.00



Book #88148-2
Pub. pr. $53.33



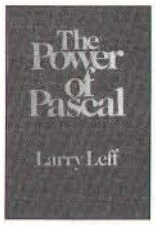
Book #53704-3
Pub. pr. $26.95



Book #69441-4
Pub. pr. $38.95



Book #82270-0
Pub. pr. $29.95



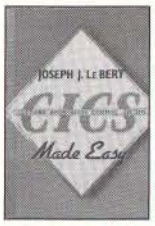
Book #68745-9
Pub. pr. $29.95



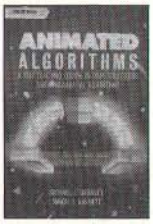
Book #73138-0
Pub. pr. $37.33



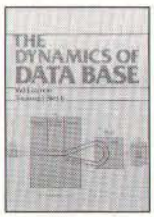
Book #63743-9
Pub. pr. $34.95



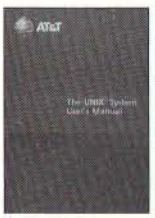
Book #13384-3
Pub. pr. $29.95



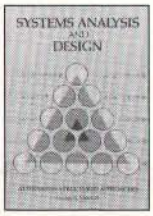
Book #03760-6
Pub. pr. $18.95



Book #22147-3
Pub. pr. $40.33



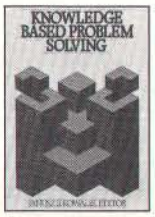
Book #93824-1
Pub. pr. $38.33



Book #R7445-1
Pub. pr. $35.00



Book #52837-2
Pub. pr. $29.95



Book #51657-5
Pub. pr. $37.33

DPBC Data Processing Book Club

Card missing? Write to:

Data Processing Book Club
A Prentice-Hall Book Club
P.O. Box 10621
Des Moines, IA 50336-0621

Keep Your Career On-line

With Books from the Data Processing Book Club

Realizing the unique challenges and problems of the Software Engineer, DPBC books provide the vital information you need to do your job more effectively. Books that streamline your toughest computing tasks. From all the leading publishers, you'll find important books you can use to sharpen your skills to a razor's edge — and advance your career.

Books Selected by Experts in the DP Field

Our advisory panel of computer professionals guarantees each selection is a major work in its field — and is the most current and comprehensive treatment of the subject.

Dramatic Savings

You save up to $48.38 on the introductory book, and keep saving 20–30% on every book thereafter.

DPBC Guarantees Convenient, Reliable Service

The Data Processing Book Club is your direct link to the books that *are* the tools of your trade!

Your Computer Bookstore by Mail

Every 3–4 weeks, you'll receive the DPBC Bulletin describing the Main Selection and Alternates. If you want the Main Selection, do nothing and it will come automatically. For an alternate selection (or none at all), mark your preference on the reply card and return it by the date specified. You'll always have at least 10 days to decide.

As a DPBC member, you are only obligated to purchase 3 books (in addition to the $4.95 selection) during the next year, and may cancel any time after that.

Choose your first book for just $4.95 — save up to $48.38!

Data Processing Book Club/A Prentice-Hall Book Club
P.O. Box 10621, Des Moines, IA 50336-0621

SEND NO MONEY! Book #_____

YES, I want the benefits of DPBC membership. Please rush me the book indicated for a 10-day free trial. If not 100% satisfied, I'll return it and owe nothing. Otherwise, I'll pay just $4.95 (plus shipping, handling and applicable sales tax, which are added to all shipments) and agree to purchase 3 additional books at members' discounts during the year, according to the terms of this offer. (Not valid without signature.)

Signature _____

Name _____

Address/Apt. _____

City/State/Zip _____

For new members only, in the Continental USA and Canada. Enrollment subject to acceptance by DPBC.

BYTE 87B36

accounting requirements, the P351 Model 2 can print six-part forms.

The Model 2 has a 4K-byte buffer and prints at 300 cps in draft mode, 250 cps in condensed mode, and 100 cps in letter-quality mode. It comes with Prestige elite and Courier fonts built in, and the company offers a wide selection of fonts on both cartridges and disks.

The P351 can emulate the Qume Sprint 11 and the IBM Graphics Printer and takes paper up to 15 inches wide. Both unidirectional and bidirectional tractor feeds and single- and double-bin sheet feeders are available as options.

Price: $1599.
Contact: Toshiba America Inc., Information Systems Division, 2441 Michelle Dr., Tustin, CA 92680, (714) 730-5000.
Inquiry 589.

Computer Service Kit

The CSK-16 from Davle Tech is a portable computer service kit packaged in a black zipper vinyl case that measures 11⅜ by 7½ by 1½ inches. The kit contains IC inserters with pin straighteners, an IC extractor with pin straightener, an anti-static wrist strap, a desoldering tool, a soldering iron, solder, soldering aid tools, a lead nipper, and a lead shear.
Price: $61.
Contact: Davle Tech Inc., 2-05 Banta Place, Fair Lawn, NJ 07410, (201) 796-1720.
Inquiry 590.

Controller Handles All Floppy Drives

Computer Peripheral's Drivemaster is a floppy disk controller for the IBM XT/AT that operates both 5¼-inch and 3½-inch drives and handles both 360K and 1.2-megabyte capacities. The board's built-in ROM software supports all DOS version 2 and 3 commands. This feature allows you to use a 3½-inch disk drive in your computer without the need for DOS 3.2. Up to four drives can be hooked up to the Drivemaster, and the board includes a built-in buffer that backs up data when media with different storage capacities are used together.
Price: $249.
Contact: Computer Peripherals, 2635 Lavery Ct., Suite 5, Newbury Park, CA 91320, (805) 499-5751, (800) 854-7600.
Inquiry 591.

Designing Newsletters with PageMaker

PageMaker Portfolio: Designs for Newsletters from Aldus contains 21 newsletter formats. The PageMaker accessory enables you to incorporate your own copy, headlines, and artwork into your project.

The program runs on the Apple Macintosh with PageMaker version 1.2.
Price: $79.
Contact: Aldus Corp., 411 First Ave. S., Suite 200, Seattle, WA 98104, (206) 622-5500.
Inquiry 592.

Maxi-Keyboard: 122 Keys Plus Software

The Ultra Memory Pro keyboard from Maxi-Switch is a 122-key keyboard that's fully compatible with all IBM-type systems. It has 25 function keys, separate cursor and numeric keypads, and switchable key click.

Of the 25 function keys, 12 are compatible with the IBM enhanced keyboard, while the other 13 can be quadrupled when used with the Shift, Alt, and Control keys.

The software lets you define key pauses, delays, and fixed and variable fields and allows automatic loading of key definitions from soft-key files. Soft keys can also be programmed to have different macros for different programs, with individual macros up to 45,000 characters long.
Price: $250.
Contact: Maxi-Switch, 9697 East River Rd., Minneapolis, MN 55433, (612) 755-7660.
Inquiry 593.

Charting the 68000

Micro Logic Corporation's Micro Chart reference card for the Motorola 68000 is the 15th of the company's series. The two-sided chart measures 8½ by 11 inches and is made of plastic. It covers detailed instruction descriptions, instruction cycle times, addressing modes, condition definitions, flag states, registers, exception processing and vectors, supervisor and user states, stacks and queues, operand conventions, pinouts, ASCII, and miscellaneous notes.

Among the other 14 reference cards available are 8086/8088, Z80, and 6502 microprocessor references, a WordStar reference card, and cards for BASIC, C, and UNIX.
Price: $5.95 (plus $1 shipping).
Contact: Micro Logic Corporation, P.O. Box 174, 100 2nd St., Hackensack, NJ 07602, (201) 342-6518.
Inquiry 594.

Taxan Big Screen RGB Monitor

Designed especially for CAD/CAM, desktop publishing, and business graphics, the Taxan Model 840 is a 16-inch RGB color monitor. When used with Taxan's 557 Gold Card, the system will automatically switch the monitor modes from CGA (640 by 200) to EGA (640 by 350) to TGA (Taxan Graphic Adapter—640 by 400).

The 840 has a bandwidth of 25 kHz, weighs 40 pounds, and measures 13½ by 15 by 16½ inches.
Price: $1195.
Contact: Taxan USA Corporation, 18005 Cortney Ct., City of Industry, CA 91748, (818) 810-1291.
Inquiry 595.

RS-232C Converter/Buffer for the Commodore

TecTrans's 98064 converter/buffer allows you to connect your Commodore 64 or 128 to any computer, modem, or printer that uses an RS-232C serial interface. The unit works bidirectionally and has a 32K-byte input buffer and a 32K-byte output buffer.

The converter/buffer can handle speeds between 225 and 57,600 bps, and protocols (issued from the keyboard) are stored in CMOS memory.
Price: $149; AC power supply, $15.
Contact: TecTrans, 6925 Rosemead Blvd., San Gabriel, CA 91775, (818) 285-3121.
Inquiry 596.

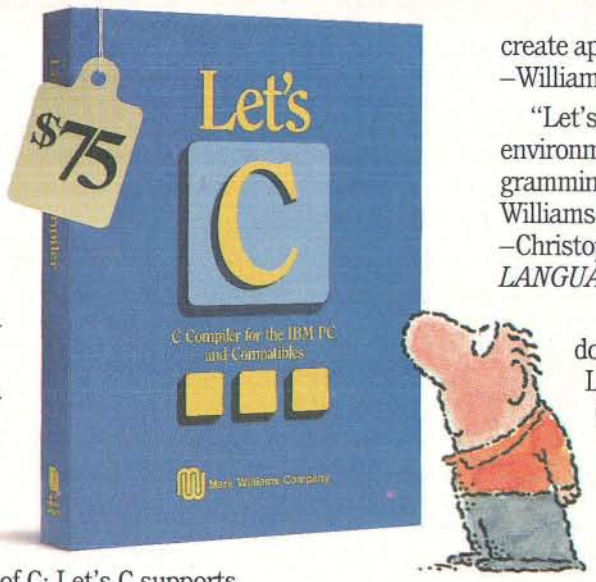
Quick, Erase Those EPROMs

Designed for low-volume users of EPROMs, the model PE-140T UV erasing lamp erases up to nine EPROMs at a time in as little as 13 minutes. This portable unit includes a conductive foam pad for protecting EPROMs against static charge and a 60-minute automatic-shut-off timer.

The high-intensity short-wave UV tube is enclosed in an anodized aluminum housing with a safety interlock mechanism to protect users against exposure to UV radiation. The PE-140T is UL listed and meets OSHA safety standards.
Price: $139.
Contact: Spectronics Corporation, 956 Brush Hollow Rd., P.O. Box 483, Westbury, NY 11590, (516) 333-4840.
Inquiry 597.

YOU ARE ABOUT TO BE SEDUCED BY POWER AND MONEY.

Admit it. You're intrigued with the idea of C programming. You may be working in BASIC, Pascal or Assembler now. But you're drawn to the power, portability and flexibility of C. And if money is what motivates you, imagine having it all for just $75 with Mark Williams Let's C.®



EVERYTHING YOU COULD ASK FOR IN A C COMPILER.

Let's C is no mere training tool. It's a complete, high quality C compiler. With the speed and code density to run your programs fast and lean. It won't get you sidetracked on some quirky aberration of C; Let's C supports the complete Kernighan & Ritchie C language–to the letter. And it comes from the family of Mark Williams C compilers, the name chosen by DEC, Intel, Wang and thousands of professional programmers.

POWERFUL UTILITIES ARE A REAL BONUS

Let's C doesn't stop with being a high performance C compiler. It includes utilities you'd expect to pay extra for–like a linker and assembler plus the MicroEMACS full screen editor with source code included. Having the source code not only allows you to customize the editor, it offers a close up, fully commented view of C programming at its best.

REVIEWERS ARE SOLD ON LET'S C, TOO.

"Let's C is an inexpensive, high-quality programming package...with all the tools you will need to create applications."
–William G. Wong, *BYTE,* August 1986.

"Let's C is a thoroughly professional C environment loaded with tools and programming utilities...another fine Mark Williams product."
–Christopher Skelly, *COMPUTER LANGUAGE,* February 1986

"The performance and documentation of the $75 Let's C compiler rival those of C compilers for the PC currently being sold for $500... highly recommended..."
–Marty Franz, *PC TECH JOURNAL,* August 1986

Features

- For the IBM-PC and Compatibles
- Fast compact code plus register variables
- Full Kernighan & Ritchie C and extensions
- Full UNIX compatibility and complete libraries
- Small memory model
- Many powerful utilities including linker, assembler, archiver, cc one-step compiling, egrep, pr, tail, wc
- MicroEMACS full screen editor with source
- Supported by dozens of third party libraries
- Upgradeable to C Programming System for large scale applications development
- Not copy protected

Let's C Benchmark Done on an IBM-PC/XT, no 8087. Program: Floating Point from BYTE, August, 1983.

Exec Time in Seconds	
Let's C	134
MS 4.0	147

MARK WILLIAMS LET'S C
$75
60 DAY MONEY BACK GUARANTEE

ADD THE *csd* DEBUGGER AND CUT DEVELOPMENT TIME IN HALF.



Invest another $75 and you've got Mark Williams revolutionary source level debugger. *csd* lets you bypass clunky assembler and actually debug in C. That's a big help when you're learning C and indispensable when you're programming. *csd* combines the interactive advantages of an interpreter with the speed of a compiler, slicing development time in half. This is how Byte Magazine summed it up: "*csd* is close to the ideal debugging environment." William G. Wong, *BYTE*, August 1986

ARE YOU STILL RESISTING?

If there's any doubt that now's the time to get your hands on the power of C, consider Mark Williams 60-day money back guarantee. You can't lose. But with Let's C and *csd*, imagine what you could gain.

Ask for Let's C and *csd* at your software dealer's, in the software department of your favorite bookstore, through the Express Program at over 5500 Tandy stores or order now by calling **1-800-MWC-1700.***

*In Illinois call 312-472-6659

Mark Williams Company

1430 West Wrightwood, Chicago, Illinois 60614

Inquiry 179

© 1986, Mark Williams Company
Let's C is a registered trademark of the Mark Williams Company
UNIX is a trademark of Bell Labs.

MARK WILLIAMS LET'S C. ONLY $75.

English PC Compatible Comes to the States

Brentwood, England–based Amstrad has started distributing its low-priced IBM PC clone in the United States. The PC 1512 comes standard with 512K bytes of RAM, an 8-MHz 8086 processor, and an integrated motherboard that contains monochrome/CGA circuitry, serial and parallel ports, a clock/calendar, and three full-length expansion slots.

Either monochrome or color monitors are available, and a two-button Microsoft-compatible mouse is included. The unit is available with one or two 360K 5¼-inch floppy disk drives or with one floppy disk drive and a 20-megabyte hard disk.

Standard software includes MS-DOS 3.2, Digital Research's DOS Plus (which will run multitasking MS-DOS and CP/M applications), and DRI's GEM (Graphics Environment Manager), including GEM Desktop, GEM Paint, and GEM Locomotive BASIC 2.

Price: $799 with single floppy drive and monochrome monitor; $899 with dual floppy drives and monochrome monitor; $999 with single floppy drive and color monitor; $1099 with dual floppy drives and color monitor; $1299 with single floppy drive, 20-megabyte hard disk, and monochrome monitor; $1499 with single floppy drive, hard disk, and color monitor.

Contact: Vidco, 1915 Harrison Rd., Longview, TX 75604, (214) 297-4898.

Inquiry 598.



The Amstrad PC 1512, a low-cost PC clone.

AT Clone Has 12 Expansion Slots

FiveStar's Korean-built FS286 is an IBM PC AT-compatible with a number of unique features. The unit comes with 12 expansion slots (six 16-bit and six 8-bit) backed up by a 242-watt power supply. FCC-approved, the FS286 also comes standard with one megabyte of RAM (expandable to 16 megabytes) and five half-height peripheral drive slots (four external and one internal). A 1.2-megabyte or 360K-byte floppy disk drive is included in the base unit.

The FS286 runs at 8 MHz (software switchable to 6 MHz) and has a built-in clock/calendar. MS-DOS 3.1 is included with the system, and it has a three-year warranty.

Price: $1695 with single floppy disk drive.

Contact: FiveStar Electronics Inc., 12900 Valley Branch #400, Dallas, TX 75234, (214) 484-4850.

Inquiry 599.

Low-Cost 65SC02 Single-Board Computer

The LCM-32 from Intrep Corporation is a low-cost single-board computer that uses the 65SC02 microprocessor, the CMOS version of the 6502. The board includes 8K bytes of CMOS RAM and a 28-pin socket for including an applications program in EPROM.

The LCM-32 has 32 individually programmable I/O lines, with four CMOS 6522 16-bit timer/counters. Two standard 26-pin headers are provided for connection to the outside world, and there's an on-board 5-volt DC regular so that the system can be powered via a battery or wall transformer.

Price: $56.95.

Contact: Intrep Corporation, 874 Jackson St., P.O. Box 5381, Napa, CA 94581, (707) 224-6000.

Inquiry 600.

Pocket-Size 6800 System

Hand Held Products has rolled out the Advanced Pocket Computer (APC), a 6800-based computer for applications that require the ultimate in portability. Measuring just 5.1 by 3.1 by 1.1 inches, the APC weighs 10 ounces and gets its power from a standard 9-volt alkaline battery. It has a full alphanumeric keyboard, a 2-line by 16-character liquid-crystal display, and 64K bytes of RAM.

The APC is programmable using its own BASIC-like language. It can also be used as a full-function calculator and can be programmed with up to eight different alarms using its built-in clock/calendar.

For those who want to develop their own custom applications, the company also offers plug-in EPROM memory modules in four different sizes. Other options are available as well.

Price: $295. 16K EPROM module, $39; 32K EPROM module, $69; 64K EPROM module, $139; 128K EPROM module, $249; 32K RAM with battery backup, $179; bar code interface, $200; RS-232C interface, $95.

Contact: Hand Held Products, P.O. Box 2388, Charlotte, NC 28211, (704) 541-1380.

Inquiry 601.

Three Speedy AT Clones

The Master Series from Intronics includes three high-speed IBM PC AT clones. The top of the line is the AT/12, which runs at a 12 MHz. With a software-switchable speed between 6 and 12 MHz, the AT/12 is able to run all AT compatible software. The AT/12 comes with one megabyte of RAM, a single 1.2-megabyte floppy disk drive, and a combined floppy/hard disk controller that can drive two floppy and two hard drives. It also has eight expansion slots (six 16-bit, two 8-bit) and a 200-watt power supply.

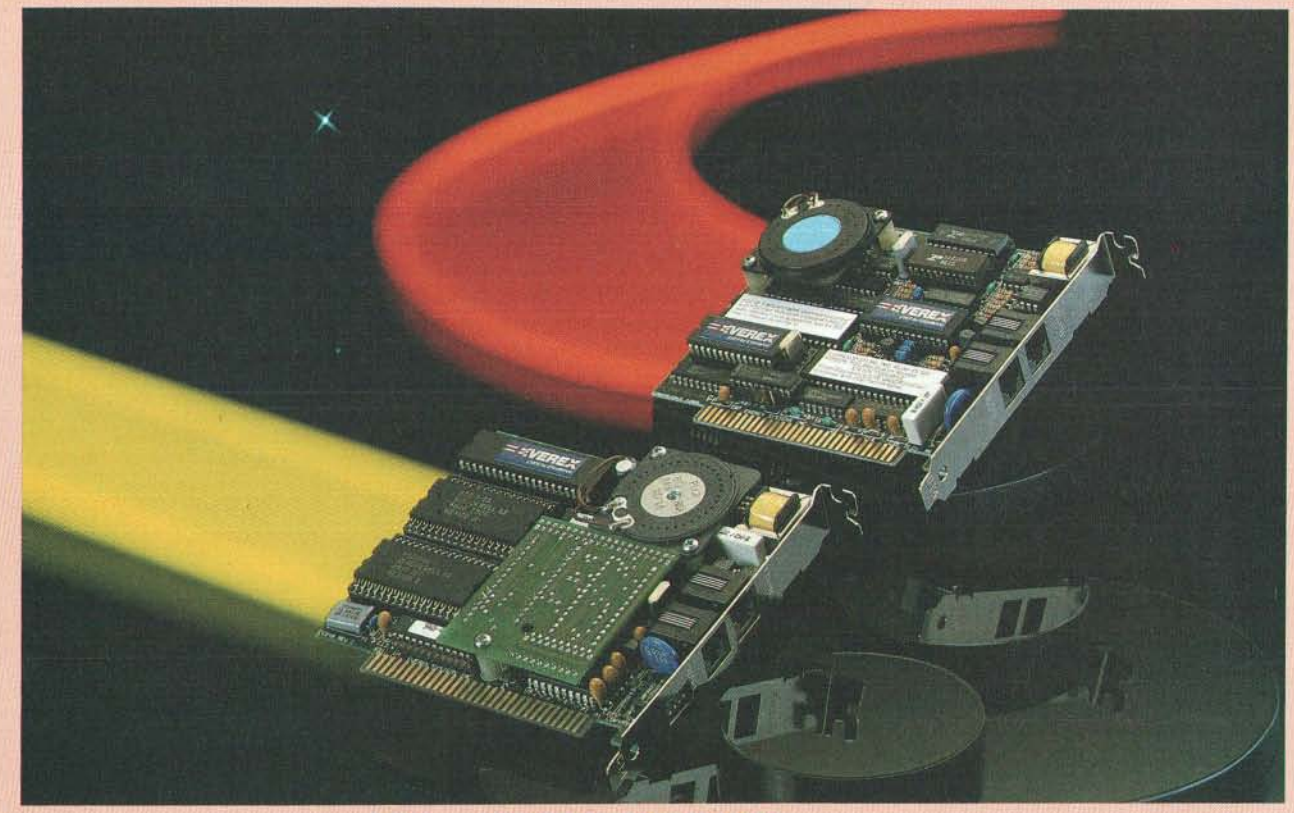
The AT/10 runs at 10 MHz and comes with 512K bytes of RAM. Otherwise, it's configured identically to the AT/12. Finally, there's the AT/10 Mini, a slightly stripped-down version of the AT/10. The Mini also runs at 10 MHz and has six instead of eight expansion slots. This results in a system with a smaller footprint than the other models.

Price: $2895 (AT/12); $2595 (AT/10); $2495 (AT/10 Mini).

Contact: Intronics Computer Corp., 1212 Knoxville St., San Diego, CA 92110, (800) 422-3366.

Inquiry 602.

We Invite You to Compare...



The EVEREX Difference: Compatibility, Reliability and Performance.

Buy modems from the company that has one of the most extensive and in-depth product lines in the industry — EVEREX. Over 400,000 boards shipped and still working strong.

If you can find a 2400 Baud modem with better compatibility, reliability and price/performance ratio, buy it! We're so confident in our products that we offer a 30 day money back guarantee.

$289 2400 Baud LIST PRICE

Features	EVERCOM II 1200 Baud	Leading Edge Model "L"
★ Hayes* AT compatible	YES	YES
★ 300/1200 baud	YES	YES
★ SW VOL control	YES	NO
★ Runs in slot 8 of IBM XT*	YES	NO
★ Runs with all versions of Smartcom II*	YES	NO
★ ROM test on command	YES	NO
★ Simplex communication	YES	NO
★ Phone-off-hook detect	YES	NO
★ Auto voice-to-data switching	YES	NO
★ Format (speed & parity) ID on command	YES	NO
★ Speed Mismatch message	YES	NO
★ Works with call waiting	YES	NO

Features	EVERCOM 24 2400 Baud	Leading Edge Model "L"
★ Hayes* AT compatible	YES	YES
★ 300/1200/2400 baud	YES	YES
★ Runs in slot 8 of IBM XT*	YES	NO
★ Runs with all versions of Smartcom II*	YES	NO
★ Runs with multi-line phones	YES	NO
★ Phone-off-hook detect	YES	NO
★ Auto data-to-voice switching	YES	NO
★ Allows "at" in lower case	YES	NO
★ Format (speed & parity) ID on command	YES	NO
★ Speed Mismatch message	YES	NO
★ Adaptive dialing	YES	NO
★ Leased line operations	YES	NO
★ Programmable response to DTR	YES	NO
★ CCITT guard tones	YES	NO
★ Self-test (RDL)	YES	NO
★ Installation program	YES	NO

1-800-821-0806 1-800-821-0807 (in CA)

48431 Milmont Dr., Fremont, CA 94538

EVER for EXcellence

EVEREX

EVEREX, EVER for EXcellence and EVERCOM are trademarks of EVEREX Systems, Inc., *Leading Edge is a registered trademark and Model "L" Series is a trademark of Leading Edge Products, Inc. *Hayes and Smartcom II are registered trademarks of Hayes Microcomputer Products, Inc. *IBM XT is a trademark of International Business Machines Corp. ©1986 EVEREX Systems, Inc. All rights reserved.

Inquiry 104 for End-Users. Inquiry 105 for DEALERS ONLY.

Oasys Rolls Out Laser Printer

The LaserPro 814 from Oasys is an eight-page-per-minute laser printer that uses the Ricoh print engine. It comes standard with 1.5 megabytes of RAM (expandable to 3 megabytes) and is compatible with the Hewlett-Packard graphics language.

The 814 emulates the HP LaserJet Plus, HP 7475A, Epson FX-80, Diablo 630, ANSI 3.64, and a standard line printer.

Office Automation Systems' proprietary EXPRESS command language is also included with the 814. EXPRESS allows users to access all printer features using English-like commands. Also included is the Pyramid Font System, a custom font-generation system that allows you to vary parameters such as typeface and point size through direct commands. OASYS claims the PFS reduces the need for additional font cartridges.

The LaserPro has a duty cycle of 10,000 copies per month and a rated life of 600,000 copies before overhaul.

Price: $5650.

Contact: Office Automation Systems Inc., 8352 Clairemont Mesa Blvd., San Diego, CA 92111, (619) 576-9500.

Inquiry 603.

Wise Old Owl SCSI Hard Disk Drive

Xebec has introduced two 5¼-inch hard disk drives for the Small Computer System Interface (SCSI). The Owl III Model 40 is a half-height drive with a formatted capacity of 40 megabytes; the Owl III Model 80D is a full-height hard disk with a formatted capacity of 80 megabytes.

Both models incorporate controller and drive electronics on a single circuit board. The Owl III drives use a rotary voice-coil positioner with an average access time of 40 milliseconds and a data path that uses a dual-port data buffer with 1:1 sector interleave.

Because of the dual actuators, dual data path, and the multiplexing capabilities of the SCSI, Xebec claims the drives are particularly well suited for multiterminal/multitasking systems.

Price: $750 (Model 40); $1295 (Model 80D).

Contact: Xebec, 3579 Highway 50 East, Carson City, NV 89701, (702) 883-4000.

Inquiry 604.

Two LED Printers from Kaypro

Kaypro's Page Printer I is a nonimpact printer that uses LED technology. Kaypro reports that it has the print quality of laser printers but requires less repair and maintenance.

The Page Printer I is rated at eight pages per minute, 5000 copies per month, and an average life of 300,000 copies between major overhauls. The unit is controlled by an 80186 microprocessor, has 128K bytes of RAM, and can emulate a Diablo 630. It has a 250-sheet input hopper, a 250-page output stacker, and can handle letter size, legal size, and most standard envelopes.

The panel of the Page Printer I has a two-line by 16-character LCD that shows machine status, current font in use, possible system errors, and notification of maintenance or service needs.

The Page Printer II is an upgraded version of the Page Printer I. Also 80186-based, it has 1.5 megabytes of RAM and can handle full-page bit-mapped graphics (300 by 300 dpi) using HPGL (Hewlett-Packard Graphics Language). The unit also emulates a graphics plotter, the HP LaserJet, and the Diablo 630.

Like its little brother, the Page Printer II has a 250-sheet input hopper, a 250-page output stacker, and can handle letter size, legal size, and most standard envelopes.

Price: $2995 (Page Printer I); $3995 (Page Printer II).

Contact: Kaypro Corp., P.O. Box N, Del Mar, CA 92014, (619) 481-4300.

Inquiry 605.

A Galaxy of Starcom Modems

SCOA Systems has introduced a new line of external and internal 1200- and 2400-bps modems. All are compatible with the Hayes AT command set and meet Bell 103/212A standards. The external modems have configuration DIP switches that are easily accessible from the front panel, eight LED status lights, and a single RJ-11C jack. The internal modems have dual RJ-11C jacks. All models feature a built-in speaker and a volume control on the rear panel. All use an 8039 microprocessor and a 40-character command buffer.

Price: 1200 SE (external 1200 bps), $299; 1200 SH (internal 1200 bps), $249; 2400 SE (external 2400 bps), $599; 2400 SB (internal 2400 bps), $579.

Contact: SCOA Systems, 2100 Golf Rd., Suite 100, Rolling Meadows, IL 60008, (312) 640-8782.

Inquiry 606.

Multi-Compatible 2400-bps Modem

The Evercom-24 from Everex Systems is a half-slot 2400-bps modem that offers full worldwide compatibility. Besides conforming to Hayes and Bell 212A/103 standards, the unit also accommodates European, Asian, Australian, and South American CCITT V.22bis standards. The Evercom uses adaptive equilization for improved performance on noisy communications lines and comes with both installation software and BITCOM communications software. The Evercom-24 includes built-in diagnostics with local analog loopback with self-test, local digital loopback, and remote digital loopback tests. For users who install an Evercom at both ends of the line, data-to-voice switching can be done automatically.

Price: $289.

Contact: Everex Systems Inc., 48431 Milmont Dr., Freemont, CA 94538, (415) 498-1111.

Inquiry 607.

High-Speed Laser Printer

The Talaris 1500 is a 15-page-per-minute laser printer with a resolution of 300 dots per inch and a full-page bit-map controller for mixing text and graphics. The 1500 features 21 standard fonts and a dual-page buffer in the 68000-based print controller that comes standard with 3.5 megabytes of RAM. You can store up to 60 fonts in the system, which is compatible with the Diablo 630, Qume Sprint, and Tektronix 4014 printers.

The 1500 uses the Ricoh LP4150 print engine, which the company claims has a lower maintenance cost than comparable speed print engines, and has a duty cycle of between 5000 and 25,000 copies per month.

The unit uses Talaris's QUIC programming language and is compatible with the company's other software products.

Price: $11,990.

Contact: Talaris Systems Inc., 5160 Carroll Canyon Rd., P.O. Box 261580, San Diego, CA 92126, (619) 587-0787.

Inquiry 608.

Here's a plug for dBASE.™

Clipper™ NEWS RELEASE

FOR IMMEDIATE RELEASE

For information contact:
Nantucket
Nantucket Corporation®
12555 Jefferson Blvd.
Los Angeles, CA 90066
(213) 390-7923

CLIPPER™ NETWORKS DBASE APPLICATIONS

LOS ANGELES, California...Nantucket's Clipper now lets developers and business persons plug an unlimited number of workstations together to run their dBASE III and dBASE III PLUS applications, using Clipper's new networking capabilities.

This new release compiles programs to run on networks that support DOS 3.1 calls for networking functions, plus single-user programs for DOS 2.0 or greater.

Compiled Applications can be distributed freely, need no runtime module, no licensing fee or royalty. And there is no extra cost per user, regardless of how many users are connected to a Clipper network. Plus the new release now packs even more of Clipper's famous speed, on both single-user and networking applications.

The new Clipper also sports Expanded Memory support, additional functions and improved memo fields. The new release, dubbed Autumn '86, is not copy protected.

Clipper Autumn '86 is available for a suggested retail price of $695. Registered users of Clipper may upgrade to the new version for $139.

Clipper and Nantucket are trademarks of Nantucket Corporation.
Other products trademarked by others. Copyright 1986, Nantucket Corporation.

PRINCETON. The in



And much more:

Full EGA and CGA support. Princeton EGA monitors bring you 64 brilliant colors and bright sharp images in enhanced graphics mode, with 640 x 350 resolution. Your EGA software never looked better. Plus our HX-12E and HX-9E automatically switch from EGA to CGA mode, when needed.

Compatibility. Princeton monitors are 100% compatible with leading personal computers like IBM®, Compaq®, and more. No matter what system you have, there's a Princeton monitor that's right for you.

Quality Image. A .28mm dot pitch (the finest dot pitch of all leading EGA displays), bright colors, and sharp resolution give Princeton monitors a quality image that cannot be beat.

Easy Viewing and Ergonomic Design. Princeton monitors are designed for easy use, too. You get easy viewing with the HX-12E's black matrix tube and etched nonglare screen. The lines are crisp, the characters sharp, and the colors even, so you're more productive. Controls are located on the front, where you can reach them.

Reliability. Princeton monitors are designed and manufactured to meet your most demanding needs. Only the finest components are used. The result: dependable performance day in and day out.

Value. No other monitor gives you more for the money than Princeton. Compare for yourself. Feature for feature there's not a better value around.

Availability. Princeton monitors are as easy to get your hands on as they are easy to use. You can find them at computer stores around the world.

Reputation. More and more, people are making Princeton Graphic Systems their number one choice in personal computer displays. Because people know Princeton delivers the ultimate in compatibility, reliability, and performance.

*Dot pitch is the measure of the distance between phosphors of like color (dots) on the display screen. The smaller the dot pitch, the closer the dots are to each other. Thus, there are more picture elements which can be displayed on the screen which results in a higher resolution.

IBM is a trademark of International Business Machine, Inc. Compaq is a trademark of Compaq Computer Corp.
Wall Street Journal is a registered trademark of Dow Jones, Inc.

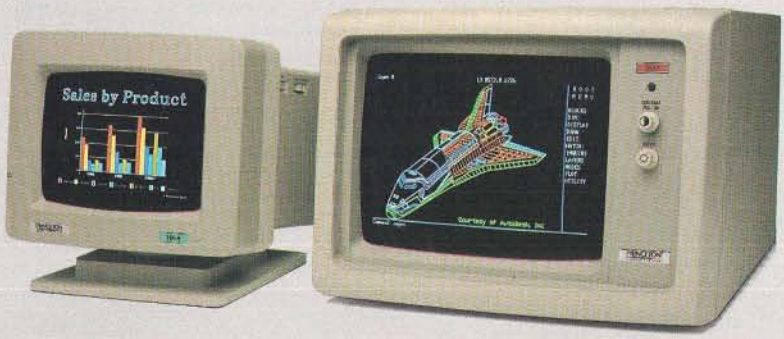
finest dot pitch* EGA monitors.

And the finer the dot pitch, the sharper the image.

For the no-compromise enhanced graphics monitors, look for the Princeton Graphic Systems name. Princeton delivers everything you need in a quality EGA display, from crisp, clear, full EGA support to rugged reliability. When you choose Princeton you choose the best.

HX-9E. The first IBM compatible 9" high resolution color monitor to support EGA. Has a .28mm dot pitch black matrix tube and etched nonglare screen for sharp, crisp displays and features a built-in tilt/swivel stand and green/amber switch.

HX-12E. The first IBM compatible high resolution color monitor to support EGA with a .28mm dot pitch. The HX-12E builds on the award winning features of the HX-12 and features 640 x 350 resolution for sharp, crisp text and colorful graphics.



PRINCETON®

GRAPHIC SYSTEMS

AN INTELLIGENT SYSTEMS COMPANY

601 Ewing Street, Bldg. A Princeton, NJ 08540, Telex: 821402 PGSPRIN, (609) 683-1660, (800) 221-1490, Ext. 1804

Inquiry 237

12.5-MHz PC Accelerator

Orchid's latest 80286 accelerator board runs at 12.5 MHz. The full-length add-in board doesn't require that the system's current processor be replaced, and it can be selected or deselected via software, so the PCturbo 286e-12 can work in systems with soldered-in processor or non-8088 processors such as V20, 8086, 80186, or 80286. The board comes with one megabyte of RAM and can support up to 4 megabytes of EMS or extended memory. It will also take an 80287 math coprocessor.
Price: $1499.
Contact: Orchid Technology, 47790 Westinghouse Dr., Fremont, CA 94539, (415) 490-8586.
Inquiry 609.

Fast88 Upgrade Speeds PCs

Microspeed has introduced an enhanced version of it Fast88 accelerator for IBM PCs and most clones. The Fast88 speeds up your system by replacing your microprocessor with a faster 8088-2 or an optional NEC V-20. It also replaces the normal 4.77-MHz system clock with a circuit that allows the computer to run at either 6.1 MHz, 6.7 MHz, or 7.4 MHz.

The Fast88 installs inside the computer system unit without using an expansion slot. The new version allows software switching of speed, though an external switching control module is optional. Also included with the new Fast88 is a device driver that allows high-speed floppy-disk formatting and copying.

Microspeed is also offering an upgrade program for existing Fast88 users.
Price: $129; $149 with V-20 option; $149 with external control option; $169 with external control option and V-20; $50 for upgrade for existing Fast88 users.
Contact: MicroSpeed Inc., 5307 Randall Place, Fremont, CA 94538, (415) 490-1403.
Inquiry 610.

Real-World Controller/ Communicator

Designed to interface with up to 72 discrete inputs or outputs (in groups of four) and up to eight latchable interrupts, PX-XIO from Step Control Limited lets you control/communicate with electrical apparatus or electronic instruments such as test equipment, assembly or inspection devices, robotics, or process control.

The board can be configured via jumper selection of inputs and outputs in groups of four, and the eight interrupts can be wired to any I/O point on the board.

The PC-XIO comes with software and documentation for use with Microsoft BASIC, Turbo Pascal, Lattice C, and 8088 assembly language. Five feet of ribbon cable is also included.
Price: $445.
Contact: Step Control Ltd., 910 St. Vincent Ave. Suite 4, Santa Barbara, CA 93101, (805) 966-9553.
Inquiry 611.

Data Acquisition for 1-2-3 Users

Microstar Laboratories' Data Acquisition Processor is a single-slot add-in card that works with Lotus 1-2-3 for real-time data I/O. Using an on-board 80186 processor and a custom ROM-resident multitasking operating system, the board performs complex real-time computations such as fast Fourier transforms, digital filtering, and thermocouple compensation. The board then sends the results directly to a 1-2-3 spreadsheet. The Data Acquisition Processor can sample at speeds as fast as 17,500 samples per second and can process data 1000 times faster than 1-2-3 alone. All data manipulation is done by the board, and results are buffered to prevent data loss. The Data Acquisition Processor comes with custom interface software. Lotus 1-2-3 is required for operation.
Price: $1595 to $2500 (depending upon configuration).
Contact: Microstar Laboratories, 2863 152nd Ave. NE, Redmond, WA 98052, (206) 881-4286.
Inquiry 612.

SCOA's Multi-Compatible Graphics Board

The Star EGA from SCOA Systems comes equipped with 256K bytes of RAM and is compatible (through software switching) with the IBM Enhanced Graphics Adapter, Color Graphics Adapter, monochrome display adapter, and the Hercules Graphics Card. It provides graphics resolution of 640 by 350 pixels in 16 colors using an enhanced color display and either 640 by 200 or 320 by 200 pixels in 16 colors using a standard color display. The board can be jumpered for operation at 4.77, 6, 8, or 10 MHz and has a light pen interface as well a connector for an RGB monitor and a standard RCA video jack.

The Star EGA Plus adds a serial and parallel port to the basic package.
Price: $499; $599 for Star EGA Plus.
Contact: SCOA Systems, 2100 Golf Rd., Suite 100, Rolling Meadows, IL 60008, (312) 640-8782.
Inquiry 613.

Taxan Color Card for all Standards

The 557 Gold Card from Taxan USA is designed for total compatibility with all software designed for use with color. The board automatically adjusts itself to accommodate the software you're using and switches among Color Graphics Adapter, Enhanced Graphics Adapter, and Taxan Graphics Adapter mode, with a resolution of 640 by 400 pixels.

Although the 557 Gold Card is matched to Taxan's line of high-resolution monitors, it will operate in EGA and TGA on any monitor with a 25-kHz scan rate.
Price: $495.
Contact: Taxan USA Corp., 18005 Cortney Ct., City of Industry, CA 91748, (818) 810-1291.
Inquiry 614.

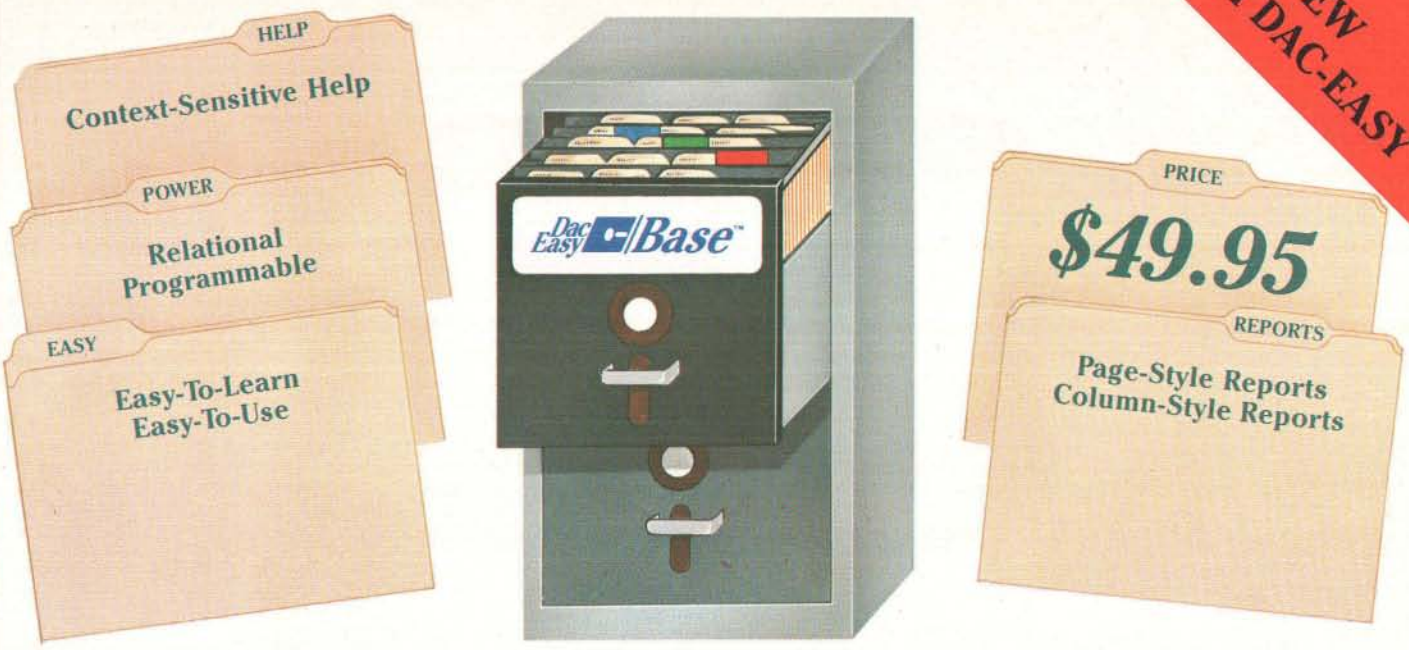
Multifunction Floppy/ Hard Disk Controller

The SMC4013-PC from Standard Microsystems is a full-slot expansion card that will control up to four disks: two standard Winchester hard disks and two 5¼-inch floppy disk drives. The board is based on several of Standard Microsystems' own MOS/VLSI circuits, including the HDC9224 Universal Disk Controller, the HDC9226 Digital Data Separator, the HDC9223 Analog Data Separator Support Circuit, the FDC9268 Floppy Disk Controller and Digital Data Separator, the SMC30002 Personal Computer Interface Circuit, and the SMC30501 Logic Array.
Price: $195.
Contact: Standard Microsystems Corporation, 35 Marcus Blvd., Hauppauge, NY 11788, (516) 273-3100.
Inquiry 615.

continued

ANNOUNCING DAC-EASY BASE

NEW FROM DAC-EASY



A POWERFUL RELATIONAL DATABASE THAT IS EASY TO LEARN, VERSATILE AND BEST OF ALL, INEXPENSIVE!

Dac-Easy Base is indeed both powerful and easy to use. It offers a multitude of unique features to help you organize, locate, and sort all kinds of alphabetic and numeric data. Dac-Easy Base continues the low price/high performance tradition of the Dac-Easy Series. With worldwide sales of over 300,000 systems, Dac-Easy has become the new leader in software designed for small businesses.

FLEXIBLE MENU SYSTEM

Dac-Easy Base is actually two systems in one. If you are a novice you will appreciate the special Beginner Menu which contains the most commonly used features for creating, editing, and printing files. The more experienced database user will find the Advanced Menu allows instant access to each and every one of the powerful routines. In both menus, you are only a keystroke away from the context-sensitive help screens. The help screens in Dac-Easy Base are so complete you may never have to consult the accompanying 200 page manual.

EASY FILE AND REPORT CREATION

Design professional-looking data input screens without leaving the menu structure. There is no need for complex programming. Once created, the edit screen allows you to input and edit your information in a matter of minutes. Also attach special notes to any of your records with the built-in MemoWriter. The MemoWriter is the perfect way to attach specific information to a single record. Custom reports are easy to create without using the available programming language. Column or page-style reports can be created quickly, and viewed on your computer screen or printed to paper. As with all reports generated by Dac-Easy Base, you can select which records will be included in your report and how they will be sorted. Special headings and subtotals can be added to give you the exact information you need.

GREAT FOR ADVANCED USERS

Yes, Dac-Easy Base is easy to use, and it is also very powerful. An unlimited number of records with up to 60 fields per record, ability to access up to three files at a time, date arithmetic capability, formula fields for calculations within files, dynamic abbreviations, and keyboard macros are just a few of the powerful features available at your fingertips. Dac-Easy Base can read and convert dBASE II files and can run DBASE II programs.



30 DAY MONEY BACK GUARANTEE

Dac offers a 30 day unconditional guarantee on all products bought directly from Dac Software (less shipping charges). There is a $10.00 restocking fee if the disk envelope is opened.

Minimum Hardware Requirements:
IBM or other compatibles, 256K memory, MS-DOS or PC-DOS 2.0 or later, two DSDD drives, color or monochrome monitor.

IBM and PC-DOS are registered trademarks of International Business Machines. MS-DOS is a trademark of MicrosSoft Corp. dBASE II is a trademark of Ashton-Tale, Inc. Dac-Easy is a trademark, and Dac-Easy Base is a trademark of Dac Software, Inc.

Inquiry 80

GREAT FOR THE HOME

There are unlimited uses for Dac-Easy Base around the home. Keep track of mailing lists, birthday lists, checkbooks, household inventories, stamp collections, recipes, client lists; and the list goes on and on. Dac-Easy Base is so easy to learn you will create your first database in no time. Call now and take advantage of the tremendous benefits of organized data.

TO ORDER
CALL TOLL FREE
1-800-992-7779
(IN TEXAS CALL 1-214-458-0038)

Mail to: **dac software, inc.**
4801 Spring Valley Rd, Bldg. 110-B
Dallas, TX 75244

Yes, please rush me ____ copies of Dac-Easy Base today. I have enclosed $49.95 (Texas residents add 7¼% sales tax) for each copy + $7.50 for shipping.

Name _____

Company _____

Address _____

City _____

State _____ Zip _____

Phone _____

Computer Brand _____

★ ★ ★ ★ Method of Payment ★ ★ ★ ★
☐ Check ☐ Money Order
☐ VISA ☐ AMEX ☐ MC

CODE 827

Turbo Prolog Toolbox Announced by Borland

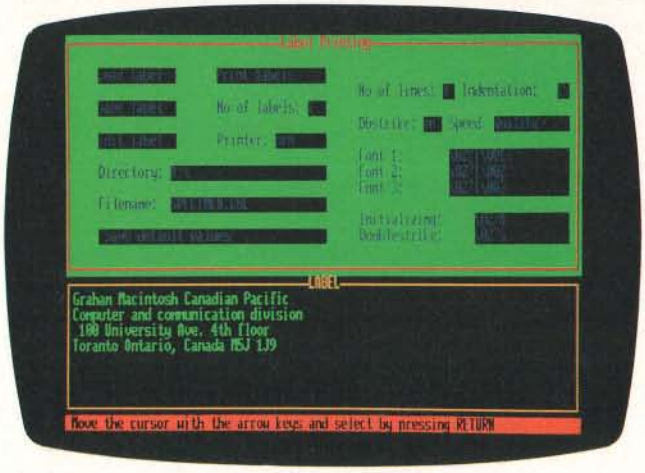
The Turbo Prolog Toolbox for IBM PCs contains over 80 tools, 40 sample programs, and source code, with which you can build expert systems, spreadsheets, database systems, communications programs, and compilers in Turbo Prolog. A report generator enables you to print reports that look the same as the screen layout, and the screen editor lets you create screen I/O functions. You can also set up context-sensitive help menus with windows containing text and graphics.

For designing communications programs, the toolbox offers you a serial communications sample program, and guidelines are provided for implementing the XMODEM protocol.

Built-in predicates allow you to incorporate status lines into your program, construct a terminal-emulation program, and import data from other programs. The source code is provided for the predicates.

The toolbox also features a parser generator, which you can use to build a parser by specifying the grammar for the language that is to be built.

Price: $99.95.
Contact: Borland International, 4585 Scotts Valley Dr., Scotts Valley, CA 95066, (408) 438-8400.
Inquiry 616.



Borland's Turbo Prolog Toolbox.

Creating Prototypes on the Macintosh

Prototyper, a program for creating prototyped applications, demonstrations, and user-interface designs, has been announced by SmethersBarnes. You use windows, pull-down menus, conditional statements, arithmetic operations, sounds, and scrolling graphics through a step-by-step process to create the double-clickable, stand-alone applications.

Price: $185.
Contact: SmethersBarnes, P.O. Box 639, Portland, OR 97207, (503) 245-7270.
Inquiry 617.

Building Applications with dBASE III

Occidental Computer Systems has announced a dBASE application builder and program-development tool called dbTEMPLATE. It includes a toolkit of standardized application program shells, complete programs, and callable procedures to perform add, change, and delete file functions.

The program shells provide you with structured code that you can modify. A Main shell provides the program that calls all subsequent functions. The ACDL shell provides Add, Change, Delete, and Look file functions. Submenu offers standard menu and submenu functions, and the Report shell is for generating single or dual file reports.

The programs and callable procedures include the Menu program for main menus and submenus, TTL title programs that provide for long or short title highlights and centering, and MSG procedures that center and display messages in a standard or blinking format to the desired row.

You also get a library of 10 dBASE III utility programs, which include Indent functions with or without connecting lines and line numbers, Find functions for single or multiple strings, Structure with DOS options, DCopy after dates, Change for string replacement, dbTree for program call reference, and NDXKey to list a dBASE or Clipper index with DOS options.

The program requires an IBM PC or compatible with 256K bytes of RAM and dBASE III.

Price: $96.
Contact: Occidental Computer Systems Inc., 21201 Oxnard St., Woodland Hills, CA 91367, (818) 712-9011.
Inquiry 618.

Common LISP

TransLISP Plus is a Common LISP system that interfaces to Microsoft C and runs on the IBM PC. The interface to Microsoft C enables you to customize LISP or combine C functions with LISP programs.

Over 400 Common LISP primitives come with TransLISP Plus, and you can create your own as well. Thirty sample programs are also included, along with an integrated editor, a trace facility, and cross-referencing. Solution Systems reports that you can port your programs to other Common LISP systems on micro, mini, or mainframe computers.

TransLISP, a smaller version of the program, is available for programmers interested in learning LISP. It includes a tutorial, demo programs, and over 300 primitives, and it enables you to write up to 12,000 lines of code. An optional run-time program is also available for TransLISP Plus.

TransLISP Plus runs on the IBM PC and compatibles with 320K bytes of RAM and a 360K floppy disk drive.

Price: $195 for TransLISP Plus; $95 for TransLISP version; $150 for the run-time version.
Contact: Solution Systems, 335 Washington St., Norwell, MA 02061, (617) 659-1571.
Inquiry 619.

Ada Compiler for the IBM PC

Meridian Software has introduced an Ada language compiler and development system. The company reports that AdaVantage implements all Ada language features, including tasking, exceptions, fixed point, generics, and separate compilation, without additional memory or coprocessor boards.

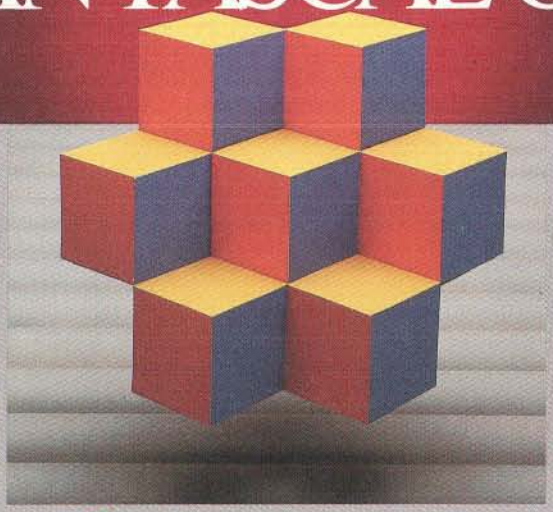
A set of tools for managing an Ada program library database is included with AdaVantage. Utility packages are also available that enable you to interface with MS-DOS, compute transcendental math functions, and examine the program environment.

AdaVantage runs on the IBM PC, XT, AT, and compatibles.

Price: $129.95.
Contact: Meridian Software Systems Inc., 23141 Verdugo Dr., Suite 105, Laguna Hills, CA 92653, (714) 380-9800.
Inquiry 620.

continued

WHY LOGITECH MODULA-2 IS MORE POWERFUL THAN PASCAL OR C.



APPRENTICE PACKAGE $99

WIZARDS' PACKAGE $199

- **Separate Compilation w/inter-module typechecking**
- **Native Code Generation**
- **Large Memory Model Support**
- **Most Powerful Runtime Debugger**
- **Comprehensive Module Library**
- **Maintainability**
- **Translator from Turbo and ANSI Pascal**

NEW!

APPRENTICE PACKAGE $99

Everything you need to begin producing reliable maintainable Modula-2 code. Includes the Compiler with 8087 support, integrated Editor, Linker, and BCD Module. We're also including FREE our Turbo Pascal to Modula-2 Translator!

NEW!

WIZARDS' PACKAGE $199

This package contains our Plus Compiler—for professional programmers or for those who just want the best. The Plus Compiler with Integrated Editor requires 512K and takes advantage of the larger memory to increase compilation speed by 50%. Our Turbo Pascal to Modula-2 Translator is also included at no extra charge.

NEW!

MAGIC TOOLKIT $99

We've put our most powerful development tools into one amazing Toolkit for use with either the Apprentice or Wizards' packages. Highlighted by our Runtime Debugger, the finest debugging tool available anywhere, the Toolkit also includes our Post Mortem Debugger, Disassembler, Cross Reference utility and Version which keeps track of different versions of one program. Our MAKE Utility figures out module dependencies and automatically selects those affected by code changes to minimize recompilation and relinking. We also provide source code of our major library modules for you to customize—or just play with.

WINDOW PACKAGE $49

Now you can build true windowing into your Modula-2 code. Features virtual screens, color support, overlapping windows and a variety of borders.

ROM PACKAGE AND CROSS RUN TIME DEBUGGER $299

For those who want to produce rommable code. You can even debug code running in ROM from your PC.

Turbo Pascal is a registered trademark of Borland International.

Call for information about our VAX/VMS version, Site License, University Discounts, Dealer & Distributor pricing.

To place an order call toll-free:

800-231-7717

In California:

800-552-8885

YES! I want the spellbinding power of LOGITECH Modula-2!

☐ Apprentice Package	$99
☐ Wizards' Package	$199
☐ Magic Toolkit	$99
☐ Window Package	$49
☐ ROM Pkg/Cross RTD	$299

Add $6.50 for shipping and handling. Calif. residents add applicable sales tax. Prices valid in U.S. only.

Total Enclosed $_____

☐ VISA ☐ MasterCard ☐ Check Enclosed

Card Number _____ Expiration Date _____

Signature _____

Name _____

Address _____

City _____ State _____

Zip _____ Phone _____

LOGITECH

LOGITECH, Inc.
805 Veterans Blvd. Redwood City, CA 94063
Tel: 415-365-9852

In Europe:
LOGITECH SA, Switzerland
Tel: 41-21-879656 • Telex 458 217 Tech Ch

In Italy:
Tel: 39-2-215-5622

WIN A FREE TRIP TO Switzerland



HOMELAND OF MODULA-2

Return your Modula-2 Registration Card or a reasonable facsimile* postmarked between March 1, 1987 and May 31, 1987 to be included in a once-only drawing!

Grand Prize: One week excursion for 2 in Zurich, Switzerland including a guided tour of ETH, the University where Modula-2 was created by Niklaus Wirth. European customers may substitute a trip to Silicon Valley, California.

Second and Third Prizes: LOGITECH C7 Mouse or LOGITECH Bus Mouse with Paint & Draw software—a $219 value, absolutely free!

*Write to Logitech, Inc. for a registration card facsimile.

Digital Electronics Analysis on the IBM PC

Micro-Logic II is a system for designing and analyzing digital electronics. It includes a mouse-driven schematic editor, component library editor, shape editor, data channel, and clock waveform pattern editors. The schematic editor can handle up to 1000 components or integrated circuit packages per drawing, Spectrum reports.

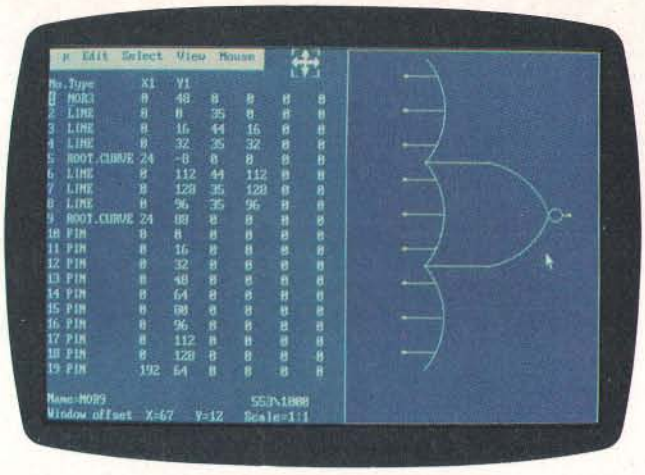
The program offers a high-speed logic and timing simulator that enables you to display simulation results in a graphical form that is similar to logic analyzer displays, according to Spectrum Software. The simulator can handle networks of up to 10,000 equivalent two-input gates.

Micro-Logic II runs on the IBM PC, XT, AT, and compatibles with 640K bytes of RAM.

Price: $895.

Contact: Spectrum Software, 1021 South Wolfe Rd., Sunnyvale, CA 94086, (408) 738-4387.

Inquiry 621.



Micro-Logic II, a digital electronic design and analysis program.

CAD on the Mac

Abvent has introduced Space Edit, a three-dimensional computer-aided design program that runs on the Macintosh. Abvent reports that the size of your vector-based documents created with Space Edit is limited only by the RAM in your system.

You can use a mouse, a graphic tablet, or a keyboard for input, and you can output to a variety of plotters and laser printers without using any special interfaces, since Space Edit has built-in drivers for many pen plotters. Your drawings can be sent by the clipboard to MacDraw, MacDraft, MacPalette, and other programs. Space Edit offers such capabilities as hidden-line removal, multilayering, and access to a three-dimensional library.

You can view objects from many vantage points using three perspective modes with Space Edit. You can choose to display your objects in wire frame or in a solid format, using the hidden-line removal capability. The changes you make to your objects automatically update the area and dimension lines.

Price: $625.

Contact: Abvent, 9903 Santa Monica Blvd., Suite 268, Beverly Hills, CA 90212, (213) 659-5157.

Inquiry 622.

Data Acquisition Software for $125

UnkelScope Junior is a data-acquisition program that can replace strip-chart recorders, x-y plotters, or oscilloscopes, according to Unkel Software. The menu-driven program displays, stores, and retrieves data, and you can port that data to other programs as well. Cursor scrolling techniques are featured, enabling you to move two independent cursors through stored data with the cursors' numerical voltage and time values displayed.

UnkelScope Junior requires an IBM PC, XT, AT, or a compatible running MS-DOS or PC-DOS 2.0 or higher. You also need a data-acquisition board and an IBM graphics board or compatible.

Price: $125.

Contact: Unkel Software Inc., 62 Bridge St., Lexington, MA 02173, (617) 861-0181.

Inquiry 623.

Macintosh Statistical Analysis

StatView 512+ enables you to perform statistical analysis, including descriptive and comparative statistics, multivariate factor analysis, and nonparametric tests. The program runs on the 512K RAM Macintosh and you can import data from other Macintosh applications, using text files or the clipboard. Using text files, you can gather data from other computers.

With StatView 512+, you can define variables, run analyses, and produce graphic views in table, scattergram, line chart, pie chart, or box plot form. Any changes you make to variables, specifications, or presentations are automatically recalculated by the program. You can also enter alphanumeric data.

Price: $349.95.

Contact: Brainpower Inc., 24009 Ventura Blvd., Calabasas, CA 91302, (818) 884-6911.

Inquiry 624.

Fast Fourier Subroutines

A pair of fast Fourier transform subroutines, written in assembly language for the 8086 family, is available from J.W. Hartwell and Associates.

One of the subroutines is designed for 16-bit integer data and is used in real-time applications when computation speed is important. Hartwell reports that a forward transformation of 1024 real-valued samples typically requires less than 150 ms. on a 6-MHz IBM PC AT, and the same sequence of points can be transformed in about 580 ms. on an 8088 running at 4.77 MHz.

The second subroutine is for single-precision floating-point data and requires an 8087 or 80287 coprocessor. It is designed for uses in which accuracy is important. Hartwell reports that a real-valued sequence of 1024 points can be transformed in less than 770 ms. on a 6-MHz IBM PC AT with an 8-MHz 80287.

Price: $149 each or $249 for both.

Contact: J.W. Hartwell and Associates, P.O. Box 515, Hillsborough, NC 27278, (919) 732-7951.

Inquiry 625.

PlotSMITH

Fulton Findings has announced PlotSMITH, a program that creates rectangular plots in ASCII from data you enter by the keyboard or through disk files. You can show 10 sets of data with up to 250 points. The files PlotSMITH creates are in ASCII format.

PlotSMITH runs on IBM PCs with 256K RAM.

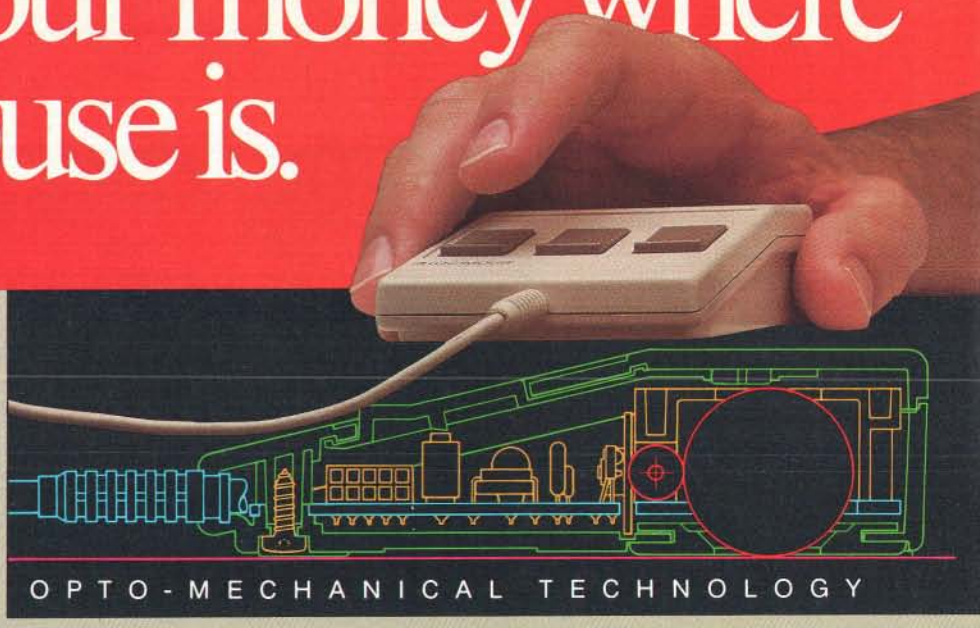
Price: $59.

Contact: Fulton Findings, 1251 West Sepulveda Blvd., Suite 800, Torrance, CA 90502, (213) 518-5045.

Inquiry 626.

continued

We put our money where our Mouse is.



LOGITECH C7 MOUSE $99

PC MAGAZINE "EDITORS CHOICE"

"...To sum up my feelings about this mouse and menu generating system: this is the one I want." *Phil Wiswell*
PC Magazine, Jan 27, 1987

At LOGITECH we've spent years perfecting our high-quality mouse hardware and software. And every LOGITECH Mouse reflects the engineering we've devoted to it.

MAXIMUM COMPATIBILITY

The programmable LOGITECH Mouse works with virtually ALL hardware and application software.

BEST MOUSE TECHNOLOGY

The opto-mechanical LOGITECH Mouse offers the best of all worlds. Mechanical tracking (a ball) and optical decoding (precise, reliable optical encoders). Every major computer manufacturer, including Apple, IBM and DEC, has chosen opto-mechanical mouse technology. LOGITECH offers the only opto-mechanical mouse on the retail market.

BEST MOUSE FOR GRAPHICS & CAD

High (200 dot per inch) resolution, precise tracking, and a 3-button design are essential for graphics and CAD.

BEST MOUSE FOR DESKTOP PUBLISHING

Ergonomic styling is a must for all mouse-intensive desktop publishing applications. High resolution is essential for high-resolution screens.

BEST MOUSE FOR SPREADSHEETS & WORD PROCESSING

The smooth-tracking LOGITECH mouse is a productivity tool for all types of data entry and editing. We've even created a special mouse interface for 1-2-3 which makes 1-2-3 users up to 30% more productive!

BEST MOUSE SOFTWARE

"Logitech's Plus Package adds an excellent menu builder (with useful examples), a fast windowing text editor, and an outstanding Lotus 1-2-3 interface." *Ezra Shapiro*
Byte, Dec. '86, pg. 324

Our Plus Software also includes our Microsoft-compatible drivers, and CLICK which sets the mouse automatically for any application.

BEST DEALS

We offer either our C7 or Bus mouse, with Plus software, packaged with some of the most exciting applications on the market, at very exciting prices.

LOGIPAINT **Special Offer! $149**

The LOGITECH Mouse with PC Paintbrush is the most advanced paint set available for the PC. It offers 11 type fonts, a pallet of 16 colors, and the ability to import and embellish files from other applications.

LOGICADD **$189**

The LOGITECH Mouse packaged with Generic CADD and Dot Plot turns your PC into a complete CADD workstation. Generic CADD offers the features and performance of high priced CADD at an unbelievably low price. DotPlot is the add on utility that enables you to produce crisp, high resolution drawings from your dot matrix printer.

LOGIPAINT-&-DRAW **$219**

The LOGITECH Mouse packaged with LOGIPAINT and LOGICADD. Together they are the complete graphics toolkit for combining freehand and technical drawings.

NEW

LOGITECH BUS MOUSE
$149 with LogiPaint

100% Microsoft Bus Mouse Compatible!

It has all the features of the LOGITECH C7 MOUSE, plus it leaves the serial port on your computer free for other peripherals. It comes standard with our-top-of-the-line Plus Software and LogiPaint.



Lotus and 1-2-3 are trademarks of Lotus Development Corp. Generic CADD is a trademark of Generic Software, Inc. PC Paintbrush is a registered trademark of ZSoft Corp.

YES! I want the opto-mechanical LOGITECH Mouse!

- ☐ LOGITECH C7 Mouse w/Drivers **$99**
- ☐ LOGITECH C7 Mouse w/Plus Software **$119**
- ☐ LOGITECH BUS Mouse w/Plus Software and LogiPaint **$149**

Additional Software
(with C7 and Plus or Bus Mouse and Plus.)

- ☐ LOGIPAINT **$149**
- ☐ LOGICADD **$189**
- ☐ LOGIPAINT-&-DRAW **$219**

Add $6.50 for shipping and handling. Calif. residents add applicable sales tax. Prices valid in U.S. only.

Total Enclosed $_____

30-Day Money-Back Guarantee/3-Year Warranty

To place a credit card order call our special toll-free number:

800-231-7717

Call toll-free in California:

800-552-8885

☐ VISA ☐ MasterCard ☐ Check Enclosed

Card Number _____ Expiration Date _____

Signature _____

Name _____

Address _____

City _____ State _____

Zip _____ Phone _____

DEALER INQUIRIES WELCOME

LOGITECH

LOGITECH, Inc.
805 Veterans Blvd. Redwood City, CA 94063
Tel: 415-365-9852

In Europe:
LOGITECH SA, Switzerland
Tel: 41-21-879656 • Telex 458 217 Tech Ch

In Italy:
Tel: 41-21-879656

Inquiry 171

Risk Analysis and Simulation

PRISM uses probabilites and simulation techniques to enable you to model uncertain or risky situations. It makes use of Monte Carlo simulation and lets you define the modules with graphic representation of probability distributions and a high-level programmable modeling language. Prism's output shows potential risks and payoffs, and you can also generate a spreadsheet of results.

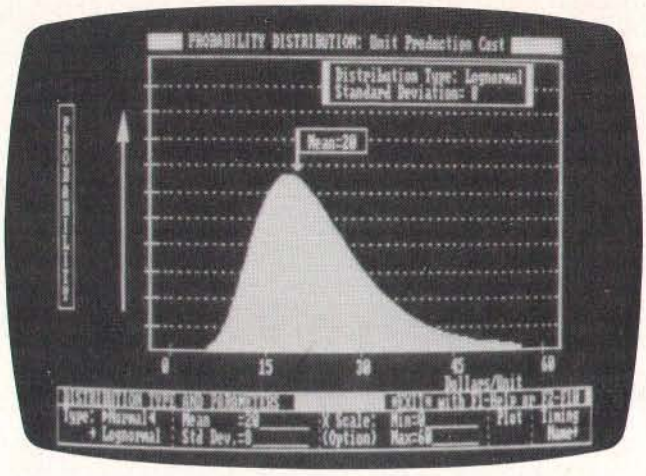
The program runs on the IBM PC, XT, AT, and compatibles with at least 512K bytes of RAM.
Price: $895.
Contact: Tempus Development Corp., 1941 North Vermont St., Arlington, VA 22207-9990, (703) 522-3780.
Inquiry 627.

Linking Laptops and IBM PCs

The Brooklyn Bridge lets you transfer files between 3½-inch disk laptops and 5¼-inch disk IBM PCs. According to White Crane Systems, the program transfers files at 115,200 bits per second, attaining a throughput of 10K bytes per second.

Besides transferring files, you can use the program to edit on a remote machine, access remote drives from within a program, and direct ouput to a laser printer, plotter, or other device.

One IBM-compatible serial port is required on each machine. The program comes with one disk for each system and a connector cable for 9- or 25-pin models.
Price: $129.95.
Contact: White Crane Systems, 6889 Peachtree Industrial Blvd., Suite 151, Norcross, GA 30092, (404) 454-7911.
Inquiry 628.



PRISM provides risk analysis using Monte Carlo simulation.

Two Word Processors for the IBM PC

Celebrity and ProofWriter are word processors that feature spelling checkers and mail-merge capabilities. Both require an IBM PC or compatible with 256K bytes of RAM.

Celebrity offers a calculator, an appointments and reminder calendar, a forms and reports system with mail-merge functions, a file-cabinet capability, and macro and command-file capabilities. The program also enables you to work in up to four windows simultaneously.
Price: $89.95.
Contact: Good Software Corp., 5429 LBJ Freeway, Suite 720, Dallas, TX 75240, (214) 6085.
Inquiry 629.

ProofWriter offers word processing in color and foreign language and scientific symbol capability. Optional versions enable you to print symbols that aren't included in the IBM PC character set, and a character generator lets you construct any printed symbol on a dot-matrix printer.

Other options offered by ProofWriter include underlining, superscripts and subscripts, software-generated shadow and bold type, italics, condensed print, and page-numbering options. ProofWriter's editor offers WYSIWYG (what you see is what you get) word processing, which gives you desktop publishing mark-up capabilities.

ProofWriter is available in a standard version for use with the IBM PC character set and an international and scientific version. Other versions are available for a variety of boards.
Price: ProofWriter, standard version, $250; international/scientific version, $125; other versions range from $300 to $475.
Contact: Image Processing Systems, 6409 Appalachian Way, P.O. Box 5016, Madison, WI 53705, (608) 233-5033.
Inquiry 630.

WHERE DO NEW PRODUCT ITEMS COME FROM?
The new products listed in this section of BYTE are chosen from the thousands of press releases, letters, and telephone calls we receive each month from manufacturers, distributors, designers, and readers. The basic criteria for selection for publication are: (a) does a product match our readers' interests? and (b) is it new or is it simply a reintroduction of an old item? Because of the volume of submissions we must sort through every month, the items we publish are based on vendors' statements and are not individually verified. If you want your product to be considered for publication (at no charge), send full information about it, including its price and an address and telephone number where a reader can get further information, to New Products Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

Mathematical Tool with Graphics

CompMath is a menu-driven mathematical program that runs on the IBM PC and compatibles with 256K bytes of RAM and PC-DOS or MS-DOS 2.0 or higher. It covers general mathematics, complex arithmetic, matrix operations, engineering, and basic statistics.

You can create two-dimensional statistical and vector operation graphs in cartesian and polar coordinates. The mathematical program also enables you to store and retrieve numerical data disk files for basic statistical analysis.

An IBM color graphics adapter or equivalent is required to run CompMath.
Price: $59.95.
Contact: Esoft Software, 444 Colton Rd., Columbus, OH 43207, (614) 491-0832.
Inquiry 631.

Photographic Switcheroo

In the What's New section of our December 1986 issue, we mistakenly swapped two photos. The screen pictured on page 30 was produced by Stella Business Graphics and should have run on page 32. The screen on page 32 was produced by VCN Concorde and should have been on page 30. Our apologies to all, and particularly to Stella Systems and Visual Communications Network.

WHO'S GOT ALL THE US STARS?



THE ASHFORD EAGLE!

Ashford is the US computer solutions export company that flies you all the newest and best technology from America's star hardware and software producers.

Direct out of Atlanta and to your door. Before your fellow dealers, OEMs, system houses or corporate purchasers have had time to run the idea up the flagpole.

INSTANT TAKE-OFF

From now on don't say no to **anything** you or your customers need. Just telex the word and the eagle gets airborne. With PC add-ons and peripherals. Plug in boards for graphics, CAD/CAM, communications, networking and mass storage. Plus the latest software applications packages.

In short, the complete galaxy of IBM environment possibilities. And beyond. In the quantities you need when you need them.

HAPPY LANDINGS

Your shipments arrive with all problems pre-solved.

Ashford takes care of licensing, customs, documentation, insurance and everything else. It wraps every item not just in the American flag but in a powerful warranty. And it provides full technical support as part of the deal.

Telex for quantity order prices and other details right now. Then, anytime you say, Ashford will reach for the stars.

PLEASE VISIT US AT HANNOVER FAIR – CEBIT '87 USA PAVILION – D6

ASHFORD INTERNATIONAL

Ashford International, Inc.
1967 Lakeside Parkway
Suite 416 Tucker
Georgia 30084, USA
Tel: (404) 9397533
Fax: (404) 9397526
Telex: 804486 ashfe intl.

European office:
Ashford International, Inc.
Av. de Beaulieulaan 25, box 8
1160 Oudergem-Brussels, Belgium
Tel: 02 660 3381
Fax: 02 660 3419
Telex: 23380 ashfe b

US HIGH TECH, FAST.

Inquiry 501

▲ Italy, tel. 02 2846 579. telex, 842469 TSA CH ▲ The Netherlands, tel. 4902 42665, telex 51569 addon nl
▲ Scandinavia, tel. 0270 8200. fax. 0270 8752. ▲ Finland, tel. 90 803 9044. telex, 121278 eldis sf ▲ In Miami call 3746120.

WHAT'S NEW

INTERNATIONAL

Isolan Fibre-Optic Transceiver for LANs

The Isolan Fibre-Optic Transceiver Type 1180 introduced by BICC Data Networks is an addition to the local area network range of ISOLAN (International Standards Organisation Local Area Network) products. It fits IEEE 802.3, ISO, and ECMA standards, allowing conventional data terminal equipment and PCs to be connected to an all-fibre-optic–based local area network. Functions include loopback of data, jabber protection, reliable collision detection, idle signal modulation, and loss of light detection and indication.

In system or network configurations, the Transceiver's interface is compatible with DTE. Using duplex fibre cable, the unit can be linked to other fibre optic products from BICC Data Networks. Installation is eased due to industry-standard optical ports, SMA connectors, and a design that allows all diameters of fibre cable to be used.

Price: £425
Contact: BICC Data Networks, 1 Frogmore Rd., Hemel Hempstead, Hertfordshire HP3 9RJ, U.K., 442-2183-83.
Inquiry 520.



ISOLAN Fibre-Optic Transceiver Type 1180.

Tandon's Target Launched at Show

Tandon (U.K.) launched the Target compact PC at the 1987 "Which Computer?" Show in London in January. The Target is an IBM AT clone with a small footprint that uses several custom VLSI chips designed by Tandon to achieve compatibility. The basic Target model has an AT-style 20-megabyte hard disk, but a high-end version features a state-of-the-art Run Length Limited disk controller chip that compresses data and gives the effect of greater disk capacity. A normal 3½-inch Winchester drive can hold 30 megabytes.

Price: £1995 for the 20-megabyte model; £2495 for the 30-megabyte model.
Contact: Tandon Ltd., Unit 19, Dunlop Rd., Hunt End, Redditch, Worcestershire B97 5XP, U.K., (0527)-46800.
Inquiry 521.

ISAM Package Uses Russian Math Theory

A new ISAM file package for the C language has been produced by MS Associates of Windsor, publishers of the Basic-to-C translator CGEN. The new package, C-Index, runs under UNIX System 5.2 and can be used as a direct replacement for the standard UNIX ISAM database C-ISAM. C-Index is based on a new mathematical model developed by Russian mathematicians called AVL Trees, which is said to offer higher performance than the B+ tree method used in traditional ISAM packages.

Price: rental to end users is £425 per month; object- and source-code license can be purchased by software houses for £10,000 to £20,000 with no run-time fees.
Contact: MS Associates, Castle Chambers, 3-9 Sheet St., Windsor, Berkshire, U.K., (0753)-842147.
Inquiry 522.

Crystal Is an Expert System Shell

Intelligent Environments of London offers an IBM PC-compatible expert system shell called Crystal. The company claims it is faster and more advanced than other shells released for PCs. It can accommodate up to 3000 rules in memory, with an unlimited number on disk, and can process rules at more than 1000 inferences per second. All rules are automatically cross-referenced, and any rule in the system can be found for display or copying in under 0.2 seconds thanks to a rule dictionary structure.

Crystal can handle both numeric and symbolic data, and it includes a number of financial, statistical, and scientific functions for performing arithmetic functions. Uncertain data can also be handled by Bayesian techniques. Several different user query formats are supported, from simple yes and no questions to custom menus of choices and full screen forms. Crystal's explanation facility allows it to explain why it asked a particular question and by what reasoning an answer was reached. Data from other popular software packages can be imported into Crystal via a range of interfaces that include Lotus 1-2-3, dBASE III, various programming languages, ASCII files, and interactive video formats. Crystal requires an IBM PC or compatible with at least 256K of RAM.

Price: £695.
Contact: Intelligent Environments Ltd., 20 Crown Passage, St. James's, London SWIY 6PP, U.K., (0l)-930-2967.
Inquiry 523.

Integrated Software for Portables

GRiD Computer Systems' integrated software applications environment for portable computers is now available under MS-DOS. The software was originally developed under GRiD's own proprietary operating system for its GRiDCase portable computer. It can now be used on the IBM Portable PC or any compatible, such as those from Toshiba and Data General, as well as on desktop PCs.

The InteGRiD software comes on 3½-inch disks and provides a multitasking environment for writing customized menu-driven applications. It is said to be

continued

Inquiry 510 ⟶

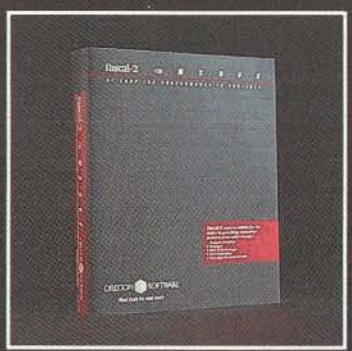


TALK OF THE TOWN

One language supports this community. That language is Pascal-2, now on the PC and producing the fastest, most compact code available. For the professional programmer, imagine what you can do with this power: ■ Cut execution time by 20% to 200% ■ Transport MS-DOS programs to VAX, PDP-11, and 68000 machines with only minor adjustments ■ Cut executable program size by up to 50% ■ Use all of DOS-addressable memory through efficient large-memory model ■ Speed error correction and save development turn-around time with sophisticated error checking and reporting ■ Find and fix logical errors with the interactive source-level debugger ■ Access DOS services

Pascal-2™

FOR MS-DOS



and network files ■ Call Microsoft FORTRAN, C, Pascal, and assembler ■ Upgrade from TURBO Pascal with compatible strings, equivalent procedures and access to TURBO graphics.

Plus!

■ *Intel CEL87 mathematical library for scientific computing* ■ *A special interface between Pascal-2 and the programmable BRIEF text editor (editor optional).* ■ *Certified ISO standard Level 1.*

Dramatically improve your productivity and introduce your PC software to the VAX next door.

Call or write OREGON SOFTWARE, INC.
6915 SW Macadam Avenue,
Portland, OR 97219 (800) 367-2202
TWX: 910-464-4779 FAX: (503) 245-8449

OREGON SOFTWARE

Real tools for real work

AT LAST THE PERFORMANCE IS PORTABLE

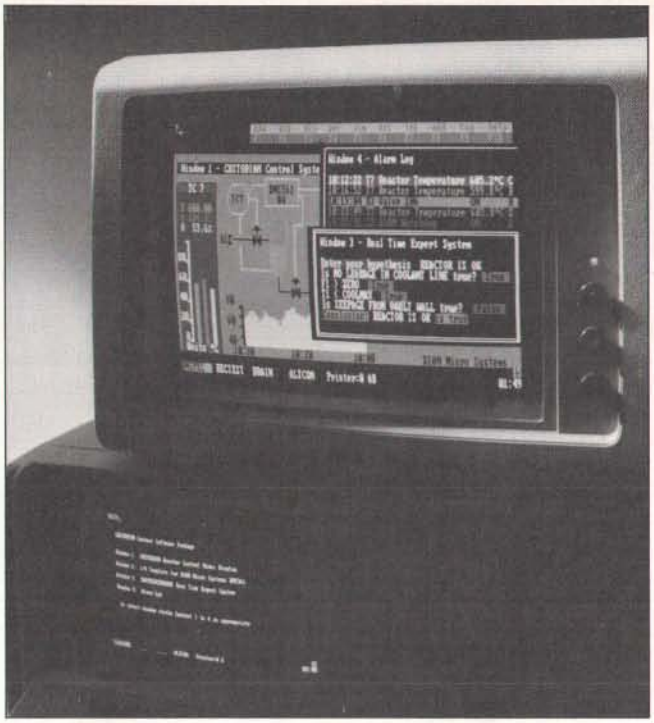
The following are trademarks: Oregon Software, Pascal-2, Oregon Software, Inc.; IBM, PC-AT, PC-DOS International Business Machines Corporation; Intel, Intel Corporation; MS, Microsoft Corp.; TURBO Pascal, Borland International, Inc.; BRIEF, UnderWare Corp.; PDP, VAX, Digital Equipment Corp.

especially suited to portable applications because these are generally of a vertical market nature. Under InteGRiD, custom applications are constructed in a special high-level language called GRiDTask, which has special support for menus and forms design. Almost 20 different prewritten software packages can be combined by InteGRiD, and several of them can be used simultaneously in separate windows, depending upon how much memory is available. The packages include electronic mail, communications, graphics, spreadsheet, word processing, database management, and a desktop organizer.
Price: £95 (or can be supplied in EPROM, for OEMs to include in their own computer designs, at £130 per license).
Contact: GRiD Computer Systems Ltd., Unit House, 33 London Rd. Reigate, Surrey RH2 9HZ, U.K., (07372)-41211.
Inquiry 524.

Generic CADD for Europe

Robotechnic Ltd. has introduced Generic CADD 2.0 to the European market. The computer-aided design package, popular in the U.S., requires an IBM PC compatible with at least 384K bytes of RAM and a CGA or EGA. Robotechnic claims that the package provides features comparable to those of dedicated CAD workstations (which normally sell for about £18,000). Generic CADD 2.0 supports arc, circle, ellipse, and polygon drawing; rubber-banding and grid-snapping; and can smooth drawings using B-spline techniques. As many as 256 colors and layers are supported given suitable output devices.

In addition to Generic CADD, Robotechnic is releasing two add-on programs, AutoConvert and DotPlot, at £25 each. The first converts files between AutoCAD and Generic CADD formats; the second permits a dot-matrix printer to output drawings.
Price: £99.
Contact: Robotechnic Ltd., 19 Queen St, Mayfair, London W1X 7PJ, U.K., (01)-499-9746.
Inquiry 525.



Dian Micro Systems Ltd.'s Custodian series.

Software Modules Link IBM PC–compatible Computers

Custodian software modules offer up to 254 tasks in multitasking integrated control software for the IBM PC family and compatible computers. The package of modules enables you to link an IBM PC with the DMS Series to produce integrated process monitoring that can be customized for a variety of applications. Features include Concurrent DOS, dynamic graphic display, alarm reporting, data logging, spreadsheet, ladder logic, historical analysis, and expert system functions. The software runs on the IBM PC, XT, AT, and compatibles including Compaq, DEC Rainbow, and Olivetti M24 machines. The PC's requirements include 640K bytes of memory, a math coprocessor, and a color graphics card.
Price: £4200.
Contact: Dian Micro Systems Ltd., Mersey House, Heaton Mersey, Stockport, Cheshire SK4 3EA, U.K., 61-442-9768.
Inquiry 526.

Apricot Upgrade Includes LAN Interface

Apricot has announced that it will supply an upgrade kit to allow owners of the older (non-IBM-compatible) Apricot PC and Xi to bring their computers up to XEN-i specification. The kit, which will be available in June, will consist of a new motherboard that contains an 80286 processor and custom VLSI chips; modifications to the monitor and keyboard are also necessary. Included with the kit will be Microsoft Windows, 640K bytes of RAM, and a LAN interface for the Apricot multiuser network.
Price: £900.
Contact: Apricot Computers plc., Apricot House, 17 Westbourne Rd., Edgbaston, Birmingham B15 3TR, U.K., (021)-454-9091.
Inquiry 527.

Three Levels of Prolog Systems

Logic Programming Associates has released three new Prolog programming systems for the IBM PC, XT, and AT. All use windows and pull-down menus.

The Professional compiler is a fully compiling version that can produce stand-alone programs and can execute 7000 logical inferences per second. Low-level facilities for handling windows and formatted I/O are included. A once-only registration fee of £100 is charged to developers who wish to distribute the run-time system with compiled programs. Three different programming environments are supported, from a simplified syntax for beginners to the standard Edinburgh syntax.

The Full Interpreter offers all the features of the compiled version in interpreted form. The Entry Level Interpreter is a cut-down version for beginners. A discount of £75 is offered to customers who upgrade from the Entry Level to the Full Interpreter.
Price: Professional Compiler, £495; Full Interpreter, £245; Entry Level Interpreter, £85.
Contact: Logic Programming Associates, Studio 4, Royal Victoria Patriotic Building, Trinity Rd., London SW18 3SX, U.K., (01)-871-2016.
Inquiry 528.

continued

Bondwell®



OEM Customers Invited

38 series

The Small PC That's As Powerful As It Is Compact

- PC/XT compatible
- 30% smaller footprint than PC
- 8088-2 CPU operating at 4.77 or 8MHz (hardware-selectable)
- 8087-2 coprocessor socket
- 640K user RAM on board
- 83-key AT²-type keyboard layout
- Keyboard lock key
- Reset button for cold boot
- 5¼", double sided, double density disk drive(s) with 360K formatted capacity each
- 20M Winchester hard disk drive (on BW38-3 only)
- Built-in real-time clock
- Standard RS232C (DTE) serial port
- Centronics parallel printer port
- 5 expansion slots
- MS-DOS¹, PC-DOS², and CP/M³ 86 operating systems supported
- MS-DOS, GW BASIC¹, RAM disk, printer spooler, and real-time clock software bundled



Despite its many built-in features, the Bondwell 38 is 30% smaller than the PC.

Bondwell®

Bondwell International Ltd. (International Sales Office) 2/F., Chung Nam Centre, 414 Kwun Tong Road, Kln., Hong Kong. Tel.: 3-419 371, Telex: 51439 BITL HX, Telefax: 3-7241252

Authorized Distributors: **Australia**—(09) 384-5511 **Austria**—(63) 172437 **Argentina**—454097 **Belgium, Netherlands, Luxemburg**—31-41392981 **Finland**—358-0-177200 **Greece**—(01) 3244150 **Italy**—0586-424668 **New Zealand**—(09) 276-5124 **Papua New Guinea**—771059 **Sweden**—40-934860 **Singapore**—338-3800 **South Africa**—786-5480 **United Kingdom**—(0462) 37171 **U.A.E. (Sharjah)**—355173 **Norway**—(02) 437320 **Switzerland**—041-448333 **Peru**—235481 **Uruguay**—295522

INTERNATIONAL

HiSoft Offers BASIC Compiler for Atari ST

A BASIC Compiler for the Atari ST released by HiSoft offers a GEM-driven editor that invokes the compiler with a keystroke or mouse click. The edit-compile-run cycle is thus speeded up because you run compiled programs directly from the editor. HiSoft BASIC is compatible with Microsoft BASIC and ST BASIC and can call both C and assembly language functions. The complete programming environment offers no limit on program size, and compiled programs execute up to 30 times faster than when interpreted. The compiler supports structured programming as well as graphics. HiSoft BASIC requires an Atari ST with at least 512K bytes of memory, a single disk drive, and a monochrome or color monitor.
Price: £100.
Contact: HiSoft, The Old School, Greenfield, Bedford MK45 5DE, U.K., 44-525-718181.
Inquiry 529.

APL with Modula-2 Creates Interactive Programming Language

A new programming language for the IBM PC and compatibles (with 360K of memory and DOS 2.11 or higher) combines APL with Modula-2 control structures to create an interactive programming environment. PL/PC's array operators allow manipulation of multidimensional arrays, and the screen text editor will position the cursor where the last error was detected. English keywords are used instead of APL symbols, and DOS files can be structured to be manipulated as a single data item of any dimension or data type. Graphic routines to draw lines, polygons, circles, and conic sections exist, and debugging facilities include tracing, stopping, single-stepping, timing, and profiling.
Price: Non-8087 standard version, $89 U.S.; 8087 version, $159 U.S.
Contact: Creative Computer Software, 117 York St., Sydney, New South Wales 2000, Australia, 02-261-1611.
Inquiry 530.

Simulate Dynamic Systems with SIMNON for the IBM PC

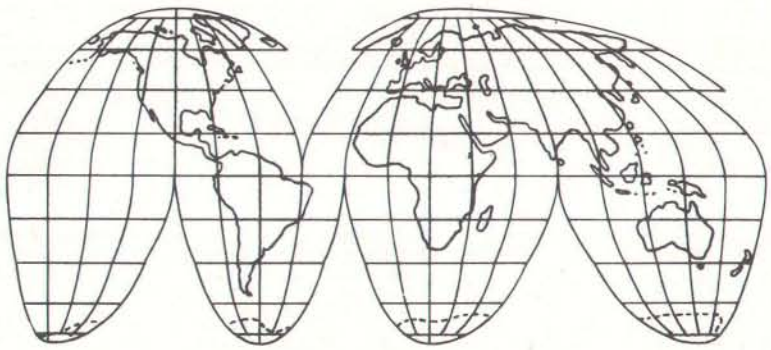
Simnon (simulation language for nonlinear systems) is an interactive simulation program of dynamic systems described by differential and difference equations. Developed at the Lund Institute of Technology in Sweden, Simnon assists research and education in automatic control, biology, chemical engineering, economics, electrical engineering, and more. Simnon's design lets the compiler detect contradictions, and its compiler generates machine instructions for Intel 8086/8087 so simulations will run as fast as FORTRAN. It requires an IBM PC, XT, AT, or compatible with 8087 or 80287 coprocessor, MS-DOS 2.0 or higher, at least 256K bytes of RAM, and a hard disk of at least 10 megabytes. It also requires one of five possible graphics combinations and an Epson-compatible printer.
Price: $695 U.S.
Contact: Department of Automatic Control, Lund Institute of Technology, Attn:

continued

WANTED

International Distributors for

STANDARD BRAND PRODUCTS



A Complete Line of Personal Computers and Enhancement Products.

Quality Products • Aggressive Prices • Proven Support

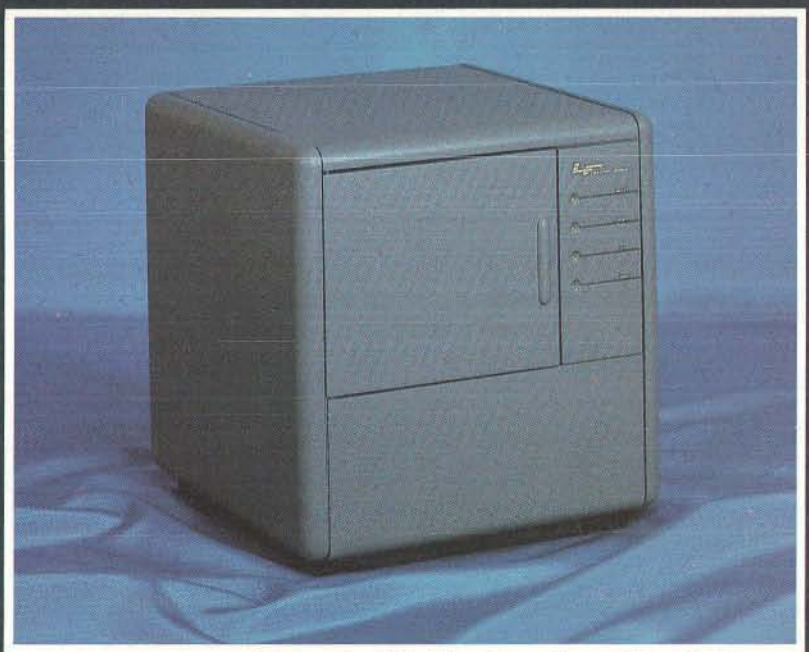
For Further Information Call Mr. Mark Eshelman With CompuAdd Corporation 512-250-1489

Only For Distributors Outside The Continental U.S.A.

Telex: 763543 COMPUADD AUS Fax: 512-250-5760

Inquiry 511

SHRINKING TO GREATER HEIGHTS



Height, Width, Depth = **11 in/27.5 cm**

CUBIX 2™

- 1-8 USERS
- UNIX SYSTEM V.2
- 1-4MB RAM
- ZERO WAIT STATES
- ETHERNET
- 220MB *FORMATTED* STORAGE
- DUAL PORTED MEMORY
- PRICED LOWER THAN MANY PERSONAL COMPUTERS

It looks different. It is different. The exciting CUBIX System V super-microcomputer from L/F Technologies is shaped for the future.

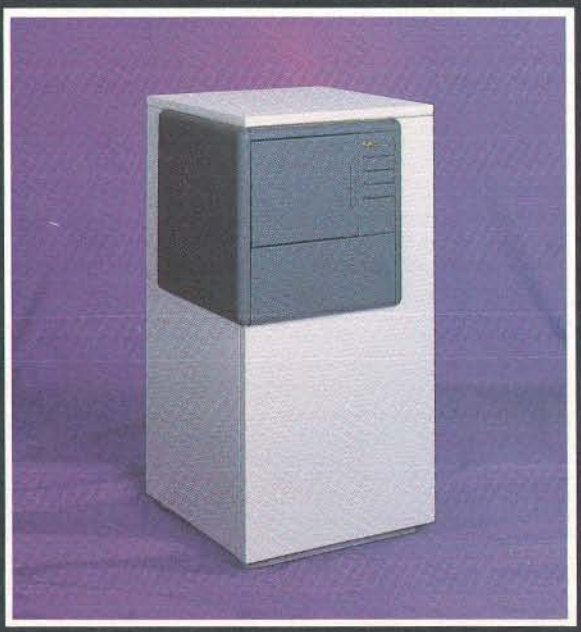
The CUBIX System V packs computer power that stuns the imagination in performance and price.

The CUBIX uses byte parity for data error-detection, operates with zero wait states, and has integrated on-line power protection for added security. Data paths between all devices have been tuned to optimize performance.

An enhanced intelligent Winchester controller increases the disk data transfer rate from 5Mb/sec. to 7.5Mb/sec., and, incredibly, increases the storage capacity of the hard disk. An 85MB unformatted drive now has an effective formatted storage capacity of 103MB!

A dual-ported memory links high speed network communications directly to the LAN interface without interrupting the system's 80286 processor, significantly increasing network performance.

An optimized UNIX port mirrors AT&T's official System V.2 release, including extras that AT&T previously restricted to big-machine versions. The CUBIX is software compatible with the AT&T 6300 Plus™.



CUBIX 3™

- 1-16 USERS
- UNIX SYSTEM V.2
- 1-8MB RAM
- ZERO WAIT STATES
- 660MB *FORMATTED* STORAGE
- DUAL PORTED MEMORY

DHRYSTONE BENCHMARK RESULTS

MACHINE TYPE	MICROPROCESSOR	OPERATING SYSTEM	DHRYSTONES/SEC NO REG
LFT CUBIX	80286 - 8 Mhz	Unix System V.2	2184
WICAT PB	68000 - 12.5 Mhz	System V	1780
Gould PN6005	No	UTX 1.1	1675
MicroVAX II	No	No	1562
IBM PC AT	80286 - 9 Mhz	SCO Xenix V	1540
Tandy II/6000	68000 - 8 Mhz	Xenix 3.0	1384
ALTOS 686	80286 - 8 Mhz	Xenix 3.2	1263
Compaq 286	80286 - 8 Mhz	Venix/286 SVR2	1326
AT&T 6300 Plus	80286 - 6 Mhz	MS DOS 3.1	1428
IBM PC AT	80286 - 8 Mhz	Venix/86 2.1	1275
AT&T 3B2/400	WE32100	Unix Sys V.2	1315
Stride	68000 - 12 Mhz	System V/68	1063
Stride	68000 - 10 Mhz	System V/68	1041
Plexus P35	68000 - 10 Mhz	Unix Sys III	984
CCC 3210	No	Xelos	849
AT&T 3B2/300	WE32000	Unix Sys V.2	735
Burroughs XE550	68010 - 10 Mhz	Centix 2.10	769

Shape your future with the CUBIX System V super-microcomputers. A new era of UNIX begins...

L/F TECHNOLOGIES

MULTIUSER COMPUTERS FOR BUSINESS AND INDUSTRY

L/F TECHNOLOGIES/CORPORATE OFFICES: 2800 LOCKHEED WAY. CARSON CITY, NEVADA 89701 • TELEPHONE: (702) 883-7611 • TWX: (910) 395-6051
POSTFACH 5427 D-6236 ESCHBORN WEST GERMANY • (49) 06196-482025 • TELEX (841) (17) 619 6977

INTERNATIONAL

Eva Schildt, P.O. Box 118, S-221 00 Lund, Sweden, 46-46-10-87-88.
Inquiry 531.

Multiple PC-based LAN Gateways

A range of PC-based communications Gateways for local area networks support the de facto standard NetBios interface protocol. Access is possible to Asynch, C-03, and X.25 links from LAN workstations.

The workstation menu allows single keystrokes to indicate the WAN connection via the Gateway. Other facilities include file transfer, conversational messages, and remote file-server access.

The Asynch and X.25 implementations allow the screen presentation format to be defined for each menu connection; screen emulations include ANSI, Prestel, VT 100, P-E1250, and Prime. The Gateway hardware consists of a short-length communications card, and the PC that contains it can be operated in either foreground or background mode.
Price: £550 for each protocol supported; each LAN workstation costs an additional £150.
Contact: The Software Forge, Folk House, Church St., Reading RG1 2SB, U.K., 0734-508131.
Inquiry 532.

XCOM/VT Connects to Local and Remote Devices

XCOM/VT provides users of IBM PC–compatible computers with access to networked PC file server capability and view-data terminal emulation. By permitting connection to local and remote asynchronous devices, the package enables the PC to transmit to serial or parallel printers and to receive ASCII or binary files. Speeds can vary from typing speed to full bps rate. A single keystroke switches between software and PC modes, and each stage of operation is menu-driven with help keys for trouble spots.
Price: £150.
Contact: X-Tec Ltd., Unit 16, Suttons Industrial Park, London Rd., Earley, Reading, Berkshire RG6 1AZ, U.K., 734-668161.
Inquiry 533.

PCT2/1 Evaluates Transputer Affordably

Parallel Computer has released hardware and software that provide the most inexpensive route to date for evaluating INMOS's parallel processing Transputer chips. The PCT2/1 board fits on the IBM PC expansion bus and contains a 16-bit T212 Transputer together with 64K of RAM and 32K of ROM. It also has a serial port and buffers for the Transputer links, plus the option of adding a video controller chip.

The software development environment, called PCT DS-1, is an implementation of the Occam 1 language, complete with its Think-Tank style folding editor. The system is said to be upward-compatible with INMOS's own TDS2 development system.
Price: PCT2/1, £695; PCT DS-1, £345; both, £995.
Contact: Parallel Computer, P.O. Box 69, Leyland, Preston, Lancashire PR5 2WG, U.K., (0772)-455270.
Inquiry 534.

ArtScribe Designs Art for the Atari ST

ArtScribe is an art and designing program for the Atari ST. It is both mouse- and menu-driven and can create lines, rays, polygons, circles, disks, ellipses, and boxes. It can hold up to five pictures in memory at once, and seven layers of magnification are enhanced by a zoom option. For graphics purposes, there are 36 user-defined color fills and 36 predefined monochrome fills as well as grab fill patterns. Up to 16 user-defined brush and pen shapes exist for users who can benefit from ArtScribe's ability to save user-defined brush fonts, palettes, and fill patterns.
Price: £24.95.
Contact: Magister Software Ltd., 100 Baker St., London W1M 1LA, U.K., (01)-486-6838.
Inquiry 535.

Universal Keyboard Chip Detects Mode

The Japanese firm Newtech has announced a universal keyboard controller chip that supports 34 different modes, including the IBM PC, AT, and IBM Enhanced Keyboard. Other formats include Apple II and standard ASCII. The chip also has an interface test mode.

The NT108-EX3 chip is a CMOS custom IC that comes in a 40-pin package. It will support 109 keys in three key-matrix arrangements and has keyboard lock and ESC key swap facilities built in. The chip can communicate with the host computer system either asynchronously at 9600 bps, via a clocked serial line, or via a parallel interface with polarity selectable strobe output. It requires only two TTL chips and a few diodes for support. The NT108 features a larger keyboard buffer than that on the standard IBM unit and will work with any popular clone BIOS such as Phoenix. A special feature for clone use is the dual IBM PC XT and AT mode in which it

continued

Do you need word processing in . . .
Arabic, Russian, Hebrew, Greek, Devanagari, Armenian, Amharic, English, European or Scandinavian languages?

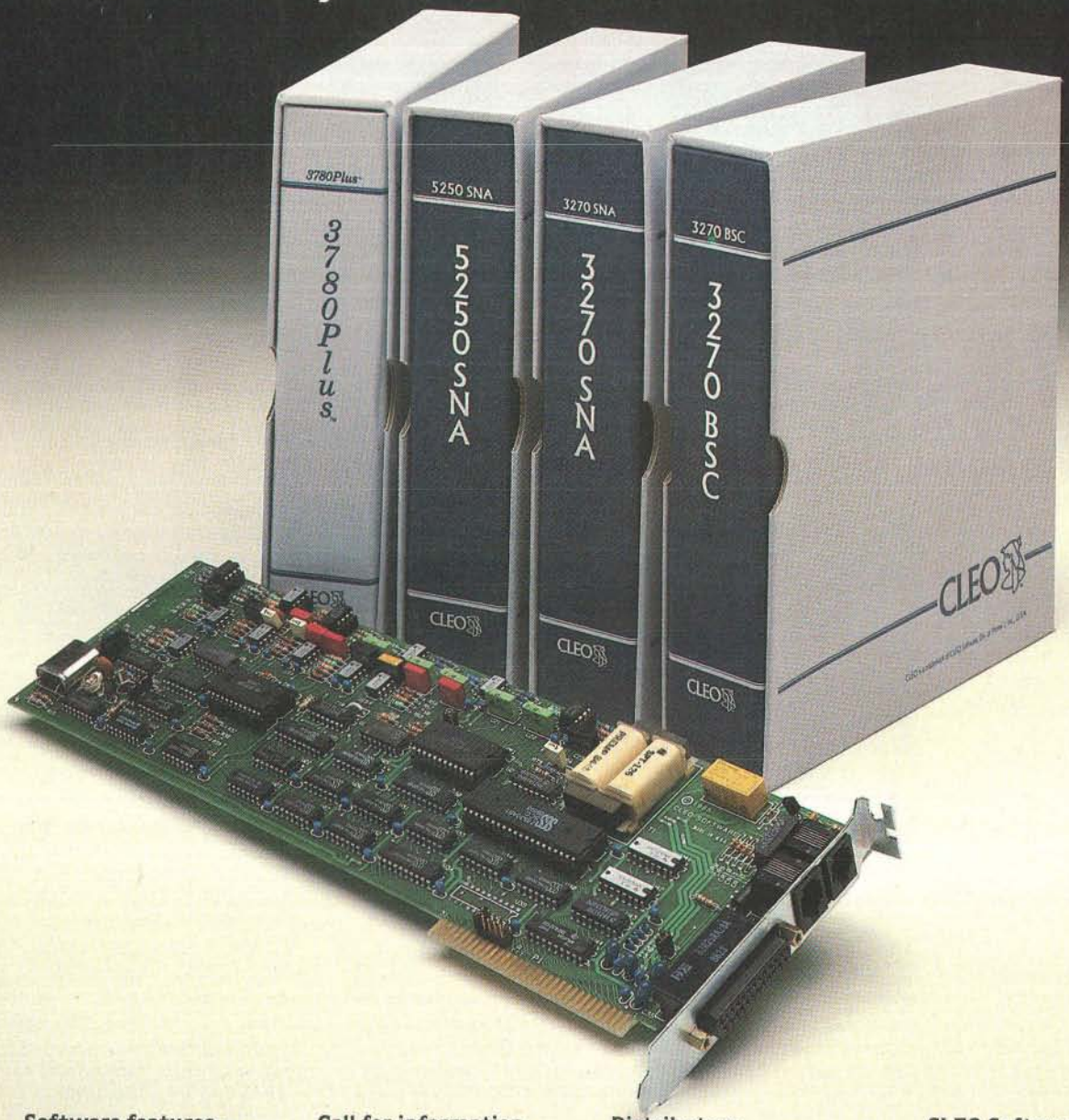
A single software program for typing, editing & printing with up to 5 languages in the same document. Full featured, multi-language word processor supports on-screen foreign characters, with accents and vowel points, with no computer hardware modifications. Arabic and Hebrew edit from right to left, and the Arabic characters change shape as you type, depending on position.

Multi-Lingual Scribe™
from
Gamma Productions, Inc.
710 Wilshire Blvd., Suite 609
Santa Monica, CA 90401
Telephone: (213) 394-8622
Telex: 5106008273 Gamma Pro SNM
VISA/MC accepted; or payment in US Dollars.
Quantity discounts available, please inquire.

Demo: US$25.00 (Includes shipping — applies toward purchase) Same as program except file size and printing have been limited. Comes with tutorial.
Program: US$375.00 (Includes shipping.) Supports dot matrix printers. Add US$150.00 for laser printer support.
REQUIRES: IBM PC, XT, AT; DOS 2.0 or higher; 512K; 1 Drive; Graphics; Dot Matrix Printer (8 or 24 pin); Laser Printers: HP Laserjet + ; or JLaser card with Canon engine based printer.

Inquiry 506

CLEO is your SNA or BSC Gateway



Software features:
- PC/XT/AT compatible
- Stand-alone or NETBIOS LAN operation
- Supports Bisync or SDLC links
- 3780 and 3270 protocols install for operation in 19 different countries
- Application program interface
- Point-to-point or multi-drop selection
- Auto-dialing with selected modems

Call for information on how one of our 5 hardware models will solve your communication problem.
- V.26/201/212 AT internal modem (2400 baud)
- V.26/201 internal modem (2400 baud)
- V.27/208 internal modem (4800 baud)
- SNA/BSC synchronous LAN gateway
- SNA/BSC stand-alone synchronous gateway

Distributors:
Benelux, Scandinavia
31(71)899202
Canada
514-737-3631
Columbia, S.A.
12875492
France
46 87 33 66
Germany, Austria, Switzerland
49(2823)18408
Italy
039 636191
Mexico
596-4825
Peru, S.A.
234-464
UK
44(1)2420012
0800-898404
U.S.A.
(313) 540-4600

CLEO Software
1639 North Alpine Road
Rockford, IL 61107
(815) 397-8110
Telex 703639

CLEO®

CLEO is a registered trademark of CLEO Software
3780Plus is a trademark of CLEO Software

can auto-detect which type of machine it is connected to, allowing the same keyboard to be used with both.
Price: 950 yen (introductory price).
Contact: Newtech Co. Ltd., 7F U-Bldg, 1-3-6, Yushima, Bunkyo-Ku, Tokyo, Japan 113, (03)-813-3891.
Inquiry 536.

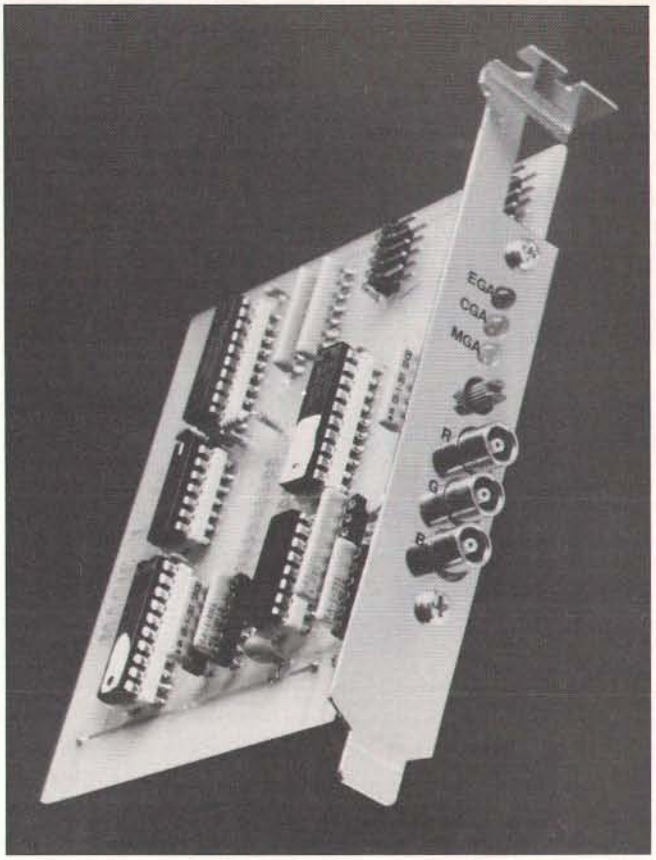
Adapter Converts IBM into Standard Analog

MAGIC-1 is a graphic adapter that plugs into an IBM PC and connects directly to the standard IBM graphic adapter. It converts signals from the IBM adapter into standard analog RGB signals used in professional display systems for both color and monochrome applications. The TTL inputs include full compatibility with the Enhanced Graphics Adapter, the Color Graphics Adapter, and the monochrome Hercules Graphics Adapter. MAGIC-1 comes with interface and 75-ohm video cables. The RGB analog output is 0.7 volts into 75 ohms.
Price: 800 francs.
Contact: Ducry & Sohn, 3 ch. Pont-Céard, CH-1290, Versoix, Geneva, Switzerland, 4122-55.42.05.
Inquiry 537.

Professional 3-D Graphics for the Mac

MAXCAD, a CAD program for the Apple Macintosh, has been released by pl GmbH of Munich. It is suitable for architects and for industrial designers. MAXCAD is object-oriented and uses a hierarchical object structure that supports the selective inclusion or exclusion of details. It also permits the definition of layers that are selectable independently of the hierarchical structure.

Advanced features include a freely definable cursor plane, so you can move a window along an inclined roof, for example, and freely definable pivot points and axes for rotating objects. Object definitions are parameterized so that new objects can be created merely by altering the dimensional parameters; you can build up a library of generic objects. Objects can be assigned middle points as construction aids for exact placement, and vectors can be defined numerically to exact length. An object can be represented in different views at the same time using the Macintosh windowing environment.
Price: 848,00 DM.
Contact: pl GmbH, c/o Thomas Nitsche, Gotthardstrasse 99, D-8000 Munchen 21, West Germany, (089)-5806099.
Inquiry 538.



Magic-1 graphic adapter from Ducry & Sohn.

C-Code Generator for Professionals

PRO-C, a C source-code generating program in MS-DOS QNX UNIX, requires 256K RAM, a hard disk, a 5¼-inch floppy disk drive, and one of five C compilers. It can produce standalone programs that are fully optimized, commented, documented, and suited to your specifications. The six integrated generator modules include record definition, screen generator, update generator, menu generator, report generator, and the PRO-C Painters, which is composed of the screen, menu, and report generators. The Painters allow manipulation of prompts, data fields, text, and box drawing. File handling is available using the ISAM file-handling technique; PRO-C will let you interface it with any other ISAM handler you use. Unlimited on-line help is accessible from any program, and generated programs do not require a run-time license.
Price: £599.
Contact: DSI Group PLC, Wickham House, 10 Cleveland Way, London E1 4TR, U.K., (01)-790-2424.
Inquiry 539.

Computer Translation in Interactive Mode

A.L.P Systems has launched a new computer-aided translation program that runs on IBM PC, AT, and Sperry IT micros.

TSS (Translation Support System) has two levels of translation automation, terminology management, source text analysis, a multilingual word processor, and the ability to print all European-language character sets. TSS works in interactive rather than batch mode, and the user can enter source text manually from the keyboard or from disk files.

The TransActive level of TSS produces a draft translation of each sentence in the text. When an ambiguity arises, TransActive queries the operator. Preferred word order and usage for a phrase can be stored and are automatically used the next time the phrase occurs. TransActive is currently available for English to French, English to German, English to Spanish or Italian, French to English, and German to English.

AutoTerm, the second level of TSS, provides automatic word-for-word lookup for specified words or phrases. Inflected forms are recognized and associated with their root form for dictionary searching purposes. TSS runs under XENIX on an AT with 2.5 megabytes of RAM and a 50-megabyte hard disk.

continued

THE TIME MACHINES



The Facit "C-line" includes the 400 cps, 15-color C7500 and the 250 cps, 7-color C5500

The 400 cps report is finished. You press a button and the printer is ready for a single sheet, 15-color business graphics. Then you change to a multi-font NLQ printout from a second connected computer. At the same time, you also change the paper path for document-on-demand. Then you...

The Facit C7500 and C5500 Matrix Printers not only handle a multitude of different applications. They permit instant switching from one application to another.

Printout options (including NLQ, multi-fonts and graphics), paper handling and all set-up parameters are changed in a matter of seconds using the "Yes" and "No" keys. Two entire parameter sets can even be pre-defined for instant selection.

All at the touch of a key.

INSTANT PAPER LOADING AND SWITCHING

To save more time, paper loading is fully automatic with a choice of three different paper paths. This enables accurate feed of multi-part invoices and paper tear-off without losing a single form. You can even hold a continuous form in stand-by while cut-sheets are printed.

To facilitate easy integration in your system, both parallel and serial interfaces are provided as standard along with Epson FX/JX or IBM Graphics Printer emulation. You can use the pre-defined set-ups to alternate between different hosts, if required.

For a demonstration of how the Facit C7500 and C5500 boost the efficiency of your computer system, contact your nearest Facit representative

It will be a real timetrip.

IBM and Epson are reg. trademarks

FACIT

Inquiry 505

Head Office: *Facit AB, S 172 91 Sundbyberg. Sweden. Phone: 46 8 764 30 00.* USA: *Facit Inc. P.O. Box 334, Merrimack. NH 03054. Phone: (603) 424-8000*

AUSTRALIA: EAI Electronics Associates Pty Ltd., 427-3322. *AUSTRIA:* Ericsson Information Systems GmbH, 0222-613 641. *BELGIUM:* Ericsson S.A., 02-243 82 11. *CANADA:* Facit Canada Inc., 416-821-9400. *CYPRUS:* LBM (Lillytos) Ltd 516 46 34. *DENMARK:* Facit A/S, 02-63 33 11. *FINLAND:* OY Facit, 90-420 21. *FRANCE:* Facit S.A., 1-4780 7117. *GREAT BRITAIN:* Facit 0634-40 20 80. *GREECE:* Computer Application Co. Ltd., 01-671 97 22. *HONGKONG:* Gilman & Co. Ltd., 5-893 00 22. *ICELAND:* Gisli J. Johnsen HF, 354-64 12 22. *INDIA:* Forbes Forbes Campbell & Co. Ltd., 22-20 48 081. *IRELAND:* Ericsson Information Systems Ltd., 75 30 93. *ITALY:* Facit Data Products S.p.A., 039-63 63 31. *JAPAN:* Electrolux (Japan) Ltd., 03-479-3411. *KOREA:* K.D.C. Corporation, 723-8555/8236. *THE NETHERLANDS:* Ericsson Information Systems B.V., 03480-709 11. *NEW ZEALAND:* Northrop Instruments and Systems, 501-801, 501-219. *NORWAY:* Ericsson Information Systems A/S, 02-35 58 20. *PORTUGAL:* Regisconta Sarl, 1-56 00 91. *SINGAPORE:* Far East Office Eqpts Pte Ltd., 745 82 88. *SPAIN:* Facit, 91-457 90 81. *SWEDEN:* Ericsson Information Systems Sverige AB, 08-28 28 60. *SWITZERLAND:* Ericsson Information Systems AG, 01-391 97 11. *WEST GERMANY:* Ericsson Information Systems GmbH, 0211-61 090.

INTERNATIONAL

Price: On application.
Contact: A.L.P. Systems, Route de Boudry 14, CH-2016 Cortaillod-Neuchatel, Switzerland, (41)-38-44-21-11.
Inquiry 540.

Graphics Supervision System from Seven Technologies

Designed to allow you to operate your IBM PC as an interactive graphics supervision workstation, Graphics Supervision System (GSS) is a package of fourth-generation software tools. You can build a system, compose with symbols, choose your windows, find trends in your data, perform operational reports, and watch your system as it displays diagrams.

GSS consists of two sets of applications, a configuration package for engineers to construct process images and a supervision package that is used in interfacing the operator with the industrial process. The GSS application software uses the GEM system software from Digital Research Inc., based primarily on the use of the mouse and the graphics monitor. GEM includes Draw, Iconedit, the Resource Construction Set, and a set of Virtual Device Interface drivers that let GEM communicate with external devices in a standardized graphics-oriented manner.

Price: Configuration module, 18,000 Danish Kroner; the base price of the supervision module is 15,000 Danish kroner and 16,000 Danish kroner with extensions such as alarm handling.
Contact: Seven Technologies, Købmagergade 26 E, 1150 Copenhagen K, Denmark, (45)-1-32-55-77.
Inquiry 541.

More 80386 Machines from Jarogate

Multiuser computer manufacturer Jarogate has added three new models to the Sprite range of Intel 80386-based machines it recently launched.

The new models come with 1, 8, and 16 megabytes of 32-bit RAM and a 70-megabyte hard disk.
Price: 1-megabyte machine, £5995.
Contact: Jarogate Ltd., Unit 2, HQ3, Hook Rise S., Surbiton, Surrey KT6 7LD, U.K., (01)-391-4433.
Inquiry 542.

PC Compatibility for BBC Micro

Watford Electronics has developed a hardware interface that brings IBM PC compatibility to the Acorn BBC B and B+ microcomputers. The later Acorn Master series machines come with IBM compatibility via an 8086 coprocessor board that is connected via the Tube high-speed parallel bus.

Watford Electronics has produced a low-cost adaptor called the Co-Pro, which permits this coprocessor board to be used on the older B and B+ models as well.

The Co-Pro may be of interest to educational users of the 500,000 BBC B units sold to date because it runs the GEM environment, as well as the majority of IBM business software.
Price: Coprocessor board, £199; Co-Pro, £50.
Contact: Watford Electronics, 250 High St., Watford WD1 2AN, U.K., (0923)-37774.
Inquiry 543.

Micro Ten/25 Copies System to IBM PC

Using the APTI Magnetlink, Micro Ten/25 lets you copy all your systems software from a System Ten/25 onto any IBM PC, XT, AT, or compatible computer. This in turn provides an independent user with a multipartitioned System Ten/25. Applications include relieving the main system from program development, serving as a backup, and making demonstrations more portable. In addition, being able to link with standard modems saves expenses. Demonstrations are available.
Price: £2950 includes Magnetlink.
Contact: Alan Livingston, Magic Systems Limited, Entech House, London Rd., Woolmer Green, Knebworth, Hertsfordshire SG3 6JR, U.K., 0438-813905.
Inquiry 544.

Graphics Pad for Amstrad and PC Compatibles

A two-dimensional CAD package from Grafsales Ltd. of Watford can run on the Amstrad PCW 8256 as well as on IBM PC clones. Grafpad 3 includes a graphics tablet for input and an audiotape Tutorial in addition to conventional documentation. The A4-sized tablet includes overlays that allow all commands to be selected from menus using the stylus, as on professional CAD/CAM workstations. The graphics software is PowerCAD from Grafsales's sister company, British Micro. PowerCAD permits zooming, panning, rubber-banding, and freehand drawing; libraries exist of user-defined symbols. Drawing can be in absolute, relative, or polar coordinates, and both imperial and metric units are supported for dimension measurement.

On IBM compatibles PowerCAD supports the CGA, EGA, and Hercules

continued

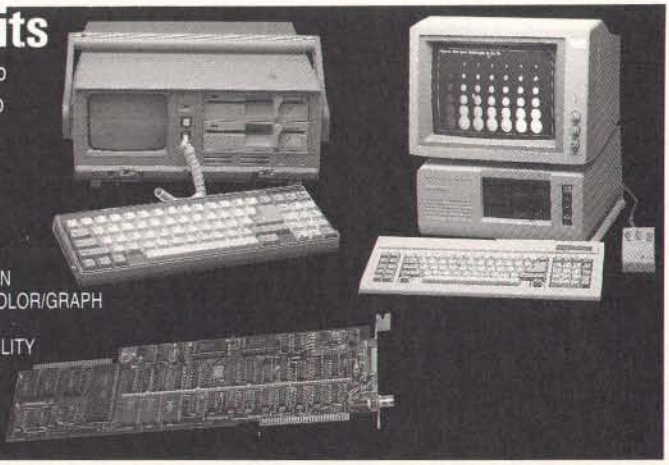
Full Range Offered for Full Profits

We specialize in the production of a full range of IBM compatibles, including Turbo XT/Baby AT, Portable XT/Baby AT and Add-On-Cards for any dealers who wish to make '87 a year of profits because our computers are high in quality but low in prices. Fast deliveries are assured. Dealers' inquiries welcome.

TURBO XT/BABY AT
GP-1600T TURBO XT
- CPU: 8088-2
- RAM: 640KB on board
- EGA CARD
- BABY AT CASE (Lock, LED, Reset Buttern)

PORTABLE XT/BABY AT
GP-3200P BABY AT
- CPU: 80286
- RAM: 512KB expand to 1MB
- One 1.2MB & One 360KB DRIVE
- 5" MONITOR, PORTABLE CASE 180W POWER SUPPLY.

EMULATOR
- NO SWITCHES
- NO JUMPER
- NO INSTALLATION
- 26TH LINE ON COLOR/GRAPH
- TSO EDIT
- IRMA COMPATIBILITY



Golden Power Enterprise Co., Ltd.
P.O. Box: 48-96 TAIPEI, TAIWAN, R.O.C. Fax: 886-2-7136237
Tel: 712-5898, 712-0735 Telex: 27139 "GOLDPOW" Taipei

Inquiry 507

ARE YOU BEING OVERLOOKED BY 116,000 EUROPEAN COMPUTER CUSTOMERS?

You probably are if you don't advertise in BYTE.

WHO READS BYTE IN EUROPE: BYTE's readers in Europe are business professionals, the "crème de la crème." Of our 116,000 readers in Europe, 75% have a university or professional degree, 93% are in either professional or technical occupations and 44% are managers, administrators, lawyers, doctors or architects.

The average European BYTE reader supervises 18 people at work, and has been using computers in business for 8 years.

WHY THEY READ BYTE: BYTE's European readers look to BYTE to keep them ahead in their profession. 82% read every issue of BYTE received and spend an average of 3 hours with each issue. 96% said they would renew their subscription if it expired today.

Half of our European subscribers pay for their own subscription and half have theirs paid for by their company. 90% find the advertisements in BYTE a valuable source of information and 88% took one or more actions as a result of the ads they saw in BYTE.

WHAT BUYING INFLUENCE THEY HAVE: BYTE's European readers are extremely influential in their companies' computer hardware and software purchase decisions. 65% of BYTE readers in Europe initiate the specifications for purchases, 58% choose the supplier and 50% actually authorize the purchase.

Since 59% of European BYTE readers work for companies with revenues over $1 million, the BYTE reader is involved in major purchasing decisions.

WHERE YOU REACH THEM: BYTE offers a special International Advertising Section which appears in the front of each issue. Your cost is low because you pay only for BYTE's circulation outside North America. In addition to this special low rate, $370 for a 51mm x 76mm black and white, $3900 for a four-color page, ads in the International section will also be seen by 58,000 BYTE readers outside Europe and North America for a total International readership of 174,000.

Call your BYTE sales office today to learn more about the influence that BYTE readers have in your market.



BYTE means business for European advertisers.

Sources: 1986 European Subscriber Study
Fall 1986 Mediamark Research

Offices: **Frankfurt** Tel: 69 72 01 81; **London** Tel: 01 493 1451; **Madrid** Tel: 1 45 52 891; **Milan** Tel: 02 86 90 617; **Nacka** Tel: 8-44 0005; **Paris** Tel: (1) 47 20 33 42; **Vienna** Tel: 222 75 76 84; **Bat Yam** Tel: 3 866 561 321 39; **Hong Kong** Tel: 5-260149; **Tokyo** Tel: 3 581-9811; **San Paulo** Tel: (11) 259-3811; **New York** Tel: (212) 512-2096

graphics adapters, and on an Amstrad PC1512 it can display 16 colors. Hard-copy output is to a variety of plotters from A5 to A0 sizes.
Price: £149.50 for Amstrad PCW8256 and 8512; £195.50 for IBM PC compatibles.
Contact: Grafsales Ltd., Unit Q2, Penfold Works, Imperial Way, Watford WD2 4YY, U.K., (0923)-43942.
Inquiry 545.

Positron In-Circuit Modular Emulator Can Be Used on PC

The Positron modular SDT816 In-Circuit Emulator system consists of an 8-/16-bit Universal mainframe with an internal power supply. The recent introduction of emulation pods for the 68000/68010 and 68008 microprocessors offer true emulation up to maximum rated clock speed (16 MHz) to existing users of the SDT emulator range. Processors that are supported include the Z80, 8085, 6502 family, 8086, 8088, 68008, and 68000/68010. The Positron modular SDT816 Universal In-Circuit Emulator can be used with a PC or simply with a terminal.
Price: £1285 to £1495, depending on the pod.
Contact: Positron Computers Limited, Unit 16, Deacon Trading Estate, Newton-le-Willows, Lancashire WA12 9XQ, U.K., 09252-29741.
Inquiry 546.

Hardware/Software V24 Analyzes Data

HiMON is a new V24 interface analyzer from Hitex-Systementwicklung of West Germany. When inserted into a V24 line, connection of the six main lines (2, 3, 4, 5, 6, and 20) can be changed and controlled. Any pair of lines 8, 11, 15, 17, and 21–24 can be monitored. However, HiMON is more than a simple breakout box; it can be connected to a PC running MS-DOS 2.0 or higher; with 256K bytes and two serial ports it can run a menu-driven software package that analyzes the data transfer on the V24 line. It operates from 110 to 19,200 bps, full or half duplex. An internal buffer of 30,000 characters can be saved for off-line analysis of the data. The start and end of monitoring can be controlled for both directions by setting triggers that respond to predefined data sequences. The status signals can be displayed in time sequence, and the time difference between characters can be monitored.
Price: 799,00 DM.
Contact: Hitex-Systementwicklung, Greschenbachstrasse 3b, D-7500 Karlsruhe 41, West Germany, (0721)-611078.
Inquiry 547.

Affordable Signal Processor Evaluation Card from Windrush

Windrush Micro Systems offers a combined hardware and software package designed for program development and evaluation. The hardware consists of a single Eurocard PCB holding a TMS32010 microprocessor chip and 4K words of memory. A Eurocard expansion bus connector allows I/O boards to be added to make a complete signal processing system. The software consists of an editor, an assembler, and a simulator program that facilitate rapid testing and program development. A program can be prepared for a simulation of the signal processor. The simulator maintains an on-screen picture of the 320 registers and can read and write to I/O devices, set breakpoints, examine the contents of the data RAM, and measure the time the CPU takes to execute a program. The program can be run at full speed using the on-board 320 microprocessor.
Price: Development package, £525; bundled with the complete disk-based system, £1235.
Contact: Windrush Micro Systems Ltd., Worstead Laboratories, North Walsham, Norfolk NR28 9SA, U.K., 0692-404086.
Inquiry 548.

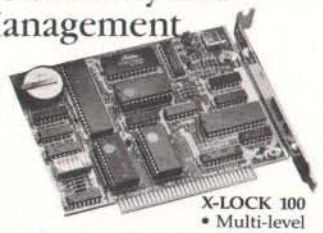
Unscrambling FORTRAN

Polyhedron Software has introduced a set of software tools called PRISM that simplify the maintenance and upgrading of FORTRAN programs on the IBM PC.

PRISM contains a program called SPAG, which unscrambles the "spaghetti" code produced by overuse of the GOTO statement. SPAG takes the source program and splits it into logical blocks, then reorders them to reduce the number of GOTOs and improve the structure of con-

continued

HACKERS BEWARE!
PC Security and Management



X-LOCK 100
• Multi-level access restriction
• File Protection
• File Encryption
• Complete Usage Reports
• Physical Locking
only $495 ea.

A-ELECTRONICS INC.
See us at CeBIT, '87
2137 Flintstone Dr. • Tucker, GA 30084
404-491-8044

Inquiry 500

THE C LANGUAGE

C COMPILERS

Every month brings a crop of the new or the repackaged. Price is not the best guide. Both the least and the most expensive here are excellent. Call us and we will advise.

Alcor C	Z80 + CP/M-80	£ 85
Aztec C Personal 1.06D	CP/M-80	£130
Aztec Commercial 1.06D	CP/M-80	£225
BDS C 1.50a	Z80 + CP/M-80	£ 75
Eco-C v3.43	Z80 + CP/M-80	£ 50
Mix C	Z80 + CP/M-80	£ 45
Toolworks C/80 v3.1	CP/M-80	£ 40
Alcor C	MS-DOS	£ 85
Aztec Apprentice	MS-DOS	£ 40
Aztec Prime	MS-DOS	£ 75
Aztec C86 Developer	MS-DOS	£210
Aztec C86 Commercial	MS-DOS	£325
CI C86 Plus	MS-DOS	£440
C-Systems C v2.0	MS-DOS	£210
De Smet C88 Starter	MS-DOS	£ 85
De Smet C88 Programmer	MS-DOS	£125
De Smet C88 Enhanced	MS-DOS	£165
De Smet C88 Prof.	MS-DOS	£200
Digital Research C	MS-DOS	£290
ECO-C88 V3.0	MS-DOS	£ 45
HIGH C (Metaware)	MS-DOS	£425
Lattice C v3.00	MS-DOS	£260
Mark Williams MWC86	MS-DOS	£385
Mark Williams LETS C	MS-DOS	£ 60
Microsoft C v4.0	MS-DOS	£260
MIX C	MS-DOS	£ 45
Toolworks C/86 v3.1	MS-DOS	£ 45
Wizard C v3.0	MS-DOS	£325
Zorland C	PC-DOS	£ 29
Aztec C86 Developer	CP/M-86	£260
Aztec C86 Personal	CP/M-86	£160
CI Optimizing C86	CP/M-86	£270
De Smet C Starter	CP/M-86	£ 85
De Smet C Programmer	CP/M-86	£125
De Smet C Enhanced	CP/M-86	£165
Digital Research C	CP/M-86	£290
Lattice C v1.04	CP/M-86	£295
Aztec C65 V1.05	Apple DOS	£150
Aztec C65 V3.20	Apple PRO-DOS	£250
Aztec C65 Prime	Apple DOS	£ 75
Aztec C68 Commercial	MACINTOSH	£325
Aztec C68 Developer	MACINTOSH	£210
Aztec C68 Personal	MACINTOSH	£150
Lattice C	ATARI	£ 75

C CROSS COMPILERS

We supply Aztec, Lattice and IAR Cross Compilers hosted on MS-DOS and targeted on Z80, 8085, 6502, 6801, 68HC11, 6301, 8051 and 68000. Please call for information or advice.

C INTERPRETERS

C-terp	PC-DOS	£195
Introducing C	PC-DOS	£ 95
Living C	PC-DOS	£ 90
Instant-C v2.0	MS-DOS	£360
RUN/C	MS-DOS	£ 65
RUN/C Professional	MS-DOS	£130
Living C	Apricot MS-DOS	£ 75
Instant-C v1.27	CP/M-86	£345

CROSS ASSEMBLERS

We supply cross-assemblers by Avocet, 2500AD, and IAR Systems for more than thirty target processors to run on MS-DOS, CP/M-86 and CP/M-80. This totals more than 200 products and we do not have space to list them all here. We hold some stock but you should allow 10-14 days for delivery. Please call for information or advice.

C LIBRARIES

DATABASE

Btrieve	MS-DOS	£190
Btrieve/Network	MS-DOS	£460
CBTREE	(source any C)	£ 80
C-Index/Plus	(source any C)	£295
C-to-dBase (source CI)	MS-DOS	£120
C-tree	(source any C)	£265
db-VISTA (most C's)	MS-DOS	£150
db-VISTA (with source)	MS-DOS	£375
Lattice dBCII	(L) MS-DOS	£175
Lattice dBCIII	(L) MS-DOS	£175
Multikey	(DS,L) MS-DOS	£170
Novum Database	(CI,DS,L) MS-DOS	£350
SoftFocus Btree	(source any C)	£ 60
Softfocus ISAM	(source any C)	£ 35

GRAPHICS

BC Graphics	PC-DOS	£ 50
GraphiC (CI,L,DS,MS3)	PC-DOS	£265
GSS Kernel	PC-DOS	£350
GSS Lattice Binding	PC-DOS	£110
GEM Prog.Toolkit (L)	PC-DOS	£400
GSX Prog.Toolkit (DR)	PC-DOS	£265
Multi-HALO (CI,L,MS3)	PC-DOS	£195
MetaWINDOWS (CI,L,MS3)	PC-DOS	£110

SCREEN & WINDOWS

Blaise View Manager	PC-DOS	£245
Curses Screen Mngr. (L)	PC-DOS	£110
Entelekon Windows(s'ce)	PC-DOS	£ 99
Panel (Most Compilers)	MS-DOS	£205
Vitamin C (source)	PC-DOS	£140
Windows for Data (most)	PC-DOS	£230
Windows for C (most C)	PC-DOS	£150
Greenleaf Datawindows	MS-DOS	£120

GENERAL FUNCTIONS

Greenleaf (source)	PC-DOS	£ 95
Smorgasbord (source)	PC-DOS	£ 75
Blaise Tools (source)	PC-DOS	£ 95
Blaise Tools 2 (source)	PC-DOS	£ 75
ESI Utility Lib(source)	PC-DOS	£155
Entelekon Funct(source)	PC-DOS	£ 99
Novum Blocks 1 (source)	PC-DOS	£150
Novum Blocks 2 (source)	PC-DOS	£150
Phoenix Pforce	PC-DOS	£245

COMMS LIBRARIES

Blaise Asynch (source)	PC-DOS	£145
Greenleaf Comms(source)	PC-DOS	£ 95
Novum Comms. (source)	PC-DOS	£140

SCIENTIFIC LIBRARIES

Wiley Scientific Lib.	ANY C	£165

PROGRAMMERS UTILITIES

PC-Lint	MS-DOS	£110
Pre-C (Phoenix Lint)	MS-DOS	£260
Figureflow C-DOC	MS-DOS	£195
C-BROWSER	PC-DOS	£190
FAST-C (debug util)(L)	PC-DOS	£195
C Helper	MS-DOS	£125
Lattice Cross Ref.	MS-DOS	£ 45
Lattice Text Utilities	MS-DOS	£ 85

ASSEMBLERS

Microsoft Macro-86 down in price.

2500AD 8086 Asm.	MS-DOS	£ 95
Dig.Res. RASM-86	MS-DOS	£180
MS Macro-86 v4.0	MS-DOS	£ 99
Phoenix Pasm-86	MS-DOS	£175

PROGRAMMING TOOLS

Ada Compilers	Algol Compilers
Assemblers	Assembler Libs.
Basic Compilers	Basic Interpreters
Basic Utilities	Basic Libraries
BCPL Compilers	C Compilers
C Interpreters	C Libraries
C Utilities	Cobol Compilers
Comms.Libraries	Cross Assemblers
Database Libs.	Debuggers
Dis-assemblers	Editors
Engineers Libs.	Expert Systems
Forth	Fortran Compilers
Fortran Libraries	Graphics Libraries
Linkers	Lisp
Modula-2	Nial Interpreters
Pascal Compilers	Pascal Libraries
Prolog	Screen Libraries
Smalltalk	Snobol

We stock many items for which there is no space in these advertisements.

PRICES & DELIVERY

Prices do not include VAT or other local taxes but do include delivery in UK and Europe. Please check prices at time of order, ads are prepared some weeks before publication.

Order by phone with your credit card.

FORTRAN COMPILERS

Lahey F77L v2.01	MS-DOS	£380
RM/FORTRAN 77	MS-DOS	£390
DR FORTRAN 77	MS-DOS	£290
MS-FORTRAN V3.31	MS-DOS	£210
Pro Fortran v2.1	MS-DOS	£220
Pro-Fortran 77	MS-DOS	£320
Utah Fortran	MS-DOS	£ 30
Pro Fortran v2.1	CP/M-86	£220
DR FORTRAN 77	CP/M-86	£290
MS Fortran-80	CP/M-80	£150
Pro Fortran V1.25	CP/M-80	£220
Nevada Fortran	CP/M-80	£ 35
Pro Fortran 77	ATARI 520ST	£120

We have Fortran Graphics Libraries and Scientific Subroutines in stock.

PROLOG LANGUAGE

PROLOG INTERPRETERS

Arity Standard	PC-DOS	£ 85
Arity Prolog v4.0	PC-DOS	£310
Chalcedony Prolog /I	MS-DOS	£ 90
Micro-PROLOG Professnl.	MS-DOS	£265
Micro-PROLOG v3.1	MS-DOS	£ 80
PROLOG-86 v2.01	MS-DOS	£115
PROLOG-1 v2.2	MS-DOS	£299
ADA Educ.Prolog	MS-DOS	£ 45
ADA FS Prolog	MS-DOS	£ 55
ADA VMI Prolog	MS-DOS	£ 85
ADA VML Prolog	MS-DOS	£165
Micro-PROLOG V3.1	CP/M-86	£ 80
Prolog-1 V2.2	CP/M-86	£299
Micro-PROLOG V3.1	CP/M-80	£ 75
Prolog-1 V2.2	CP/M-80	£225

PROLOG COMPILERS

Arity Intrprtr+Compiler	PC-DOS	£685
Prolog-2 Personal	PC-DOS	£145
Prolog-2 Programmer	PC-DOS	£495
Prolog-2 Professional	PC-DOS	£995
Turbo-Prolog v1.1	PC-DOS	£ 60

GREY MATTER
4 Prigg Meadow, Ashburton, Devon TQ13 7DF.
TEL. (0364) 53499

GREY MATTER
4 Prigg Meadow, Ashburton, Devon TQ13 7DF.
TEL. (0364) 53499

GREY MATTER
4 Prigg Meadow, Ashburton, Devon TQ13 7DF.
TEL. (0364) 53499

Inquiry 508

trol flow. A built-in "pretty print" feature permits the improved program to be listed in an indented, block-structured form that resembles Pascal and is much easier to read. Polyhedron says that SPAG treatment eases the maintenance of large FORTRAN programs that grow up in an ad hoc fashion, and thus prolongs their economic life.

Another part of PRISM, called CRAM, is an automatic overlay generator that splits up a program and produces an overlay "script" that is ready to input to an overlay linker. CRAM produces a printed report that highlights the structure of the overlayed program, including a cross-reference of subroutine calls and checking of argument consistency between modules.

CMAKE is similar to the UNIX make utility and manages the recompilation of modified subprograms. Unlike make, though, it produces its own dependency file automatically; it can handle include files nested to any depth. The only version available at this time is for the IBM PC AT licensed for four users and requires 384K RAM and an 8087/80287. Demonstration disks for the IBM PC are available on request.
Price: £1490, for four-user license only.
Contact: Polyhedron Software, Plough Close, Shillingford, Oxford OX9 8EX, U.K., (086732)-8561.
Inquiry 549.

Multichannel Data Logger from Delta-T Devices

A weatherproof data logger that can store 128,000 readings from 60 sensors is fully programmable. The Delta Logger minimizes power usage by automatically switching to a "sleep" state between readings; its power source is a battery-protected solid-state memory. Once programmed, the data logger can operate up to one million readings or can run up to approximately one year. The reading range can be defined by the logger so that errors stand out and the logger can process data to convert readings into engineering units.



Fully programmable Delta Logger from Delta-T Devices.

Price: £1050.
Contact: Delta-T Devices Ltd., 128 Low Rd., Burwell, Cambridge CB5 OEJ, U.K., 638-742922.
Inquiry 550.

68020 Gets Logic Analyzer Disassembler

Philips Test & Measurement's PM 3570 logic analyzer disassembler now supports the 32-bit 68020 microprocessor for direct processor connection. Its dual state/timing architecture has up to 83 simultaneous state analysis channels plus 32 more for timing analysis. Eleven channels remain open for other signal inputs. The 32 transitional timing analysis channels operate at a clock rate of 100 MHz but can also be used as 8 channels operating at 400 MHz or 16 channels at 200 MHz. Marketed as a 68020 support package, the PM 3570 contains the PM 8817/37 personality adapter complete with pin-grid mounting and the PM 8858/30 disassembler package that fits onto the logic analyzer's option board.
Price: $4750.
Contact: Philips Industrial & Electro-acoustic Systems Division, I&E Press Office, Building HKF, P.O. Box 218, 5600 MD Eindhoven, The Netherlands, 040-788620.
Inquiry 551.

PC+Filofax=Portex

A new software package from Showerings Business Systems combines the personal computer with a Filofax-style pocket diary. Portex is a computerized address book, diary, word processor, and spelling checker that can print data sheets on stationery that fits into the leather binder that is included. Filofax stationery can also be supplied.

Portex, which runs on the IBM PC, XT, AT, and compatibles, has a perpetual diary that can set, check, and review appointments and runs for a 200-year period. Various formats, from 1 to 14 days per page, can be chosen. The address book is self-sorting, and data can be imported from other software. The word processor has a mail-merge facility that can take names and addresses from the address book, while the spelling checker uses the 80,000-word Proximity/Collins Linguibase dictionary.
Price: £86.50.
Contact: Showerings Business Systems, South Bank Technopark, 90 London Rd., London SE1 6LN, U.K., (01)-922-8821.
Inquiry 552.

Digital Waveform Generator Has 32 Channels

A 32-channel digital waveform generator, the WS-1001, provides up to 31 synchronous waveforms that are programmable at data rates of up to 15 MHz. It is intended for use in digital circuit testing, data-transmission-system testing, microprocessor-based product diagnostics, and digital-to-analog converters. Waveform definitions are created on the host computer and sent via an RS-232 interface to the unit as a string of ASCII codes. The WS-1001 is supplied as a plug-in module or as a board. Software support for translation is in BASIC.
Price: Tektronics module, £1922; board, £495.
Contact: Walmsley Microsystems Ltd., Aston Science Park, Birmingham B7 4BJ, U.K., 21-359-0981.
Inquiry 553.

If you want your new product to be considered for publication (at no charge) in the international section of BYTE, send full information about it, including its price and an address and telephone number where readers can get further information, to the following addresses: German-language press releases: New Products, BYTE, c/o Uwe Goetzke, P.O. Box 3427, D-6750 Kaiserslautern, West Germany. All other languages: Dick Pountain, BYTE, McGraw-Hill Publishing Co., 34 Dover St., London W1X 3RA, U.K.

EVENTS AND CLUBS

March 1987

EVENTS

Spring National Design Engineering Show and Conference, Chicago, IL. Show Manager, Spring National Design Engineering Show, 999 Summer St., Stamford, CT 06905, (203) 964-0000. *March 2–5*

Second International Conference on CD ROM, Seattle, WA. Microsoft Corp., 16011 NE 36th Way, P.O. Box 97017, Redmond, WA 98073-9717, (206) 447-1986. *March 3–5*

Hannover Fair CeBIT '87, Hannover, West Germany. Deutsche Messe- und Ausstellungs-AG, Messegelände, D-3000 Hannover 82, West Germany, tel: (05 11) 89-1, telex: 9 22 728 messe d. *March 4–11*

Securicom 87: Fifth Worldwide Congress on Computer and Communications Security and Protection, Paris, France. Securicom, 8, rue de la Michodiere, 75002 Paris, France, tel: 47.42.41.00, telex: 250303 PUBLIC X PARIS. *March 5–7*

FOSE '87: Federal Office Systems Expo, Washington, DC. National Trade Productions Inc., 2111 Eisenhower Ave., Suite 400, Alexandria, VA 22314, (800) 638-8510; in the Washington area, (703) 683-8500. *March 9–12*

SMIA Meeting on Artificial Intelligence, Puebla, Mexico. Sponsored by Mexican Society of Artificial Intelligence. Mat. Warren Greiff, Department of Computer Systems Engineering, University of the Americas, Apartado Postal 220, Sta. Catarina Martir, 72820 Puebla, Mexico. *March 12–13*

Tenth Annual PACS Computer Festival, Philadelphia, PA. Stephen Longo, Philadelphia Area Computer Society, c/o La Salle University, Philadelphia, PA 19141, (215) 951-1255. *March 14*

Computer Fair 11: People and Computers Now, Kenosha, WI. David Kanecki, Applied Computer Science, University of Wisconsin-Parkside, P.O. Box 2000, Kenosha, WI 53140. *March 21*

NGCA's Computer Graphics '87, Philadelphia, PA. National Computer Graphics Association, 2722 Merrilee Dr., Suite 200, Fairfax, VA 22031, (703) 698-9600. *March 22–26*

Video Computer Animation at Compugraph Designs/MTI. Sponsored by NYC/ACM SIGGRAPH and New York University. Ed Kramer, Compugraph Designs/MTI, 885 Second Ave., New York, NY 10017, (212) 355-0510. *March 24*

Southcon/87, Atlanta, GA. Electronics Conventions Management, 8110 Airport Blvd., Los Angeles, CA 90045-3194, (213) 772-2965. *March 24–26*

Third International Conference on Creating Patient Information Systems (Computerization of Medical Records), Chicago, IL. Institute for Medical Record Economics Inc., 121 Mount Vernon St., Boston, MA 02108, (617) 720-2229. *March 24–27*

Student Computer Fair '87, Camillus, NY. Boces Regional Computer Center, 6820 Thompson Rd., P.O. Box 4866, Syracuse, NY 13221, (315) 433-8319. *March 28*

Small Computers in Libraries '87, Arlington, VA. Meckler Publishing, 11 Ferry Lane West, Westport, CT 06880, (203) 226-6967. *March 30–April 1*

IEEE INFOCOM '87: Global Networks—Concept to Realization, San Francisco, CA. Izhak Rubin, IEEE INFOCOM '87, 6731 Boelter Hall, Electrical Engineering Dept., University of California, Los Angeles, CA 90024, (213) 825-2327. *March 30–April 2*

1987 IEEE International Conference on Robotics and Automation, Raleigh, NC. Harry Hayman, Exeter C3037, Boca Raton, FL 33434, (305) 483-3037. *March 30–April 3*

AIDD 27th Annual Convention and Technology Exposition, St. Louis, MO. American Institute for Design and Drafting, 966 Hungerford Dr., Suite 10 B, Rockville, MD 20850, (301) 294-8712. *March 31–April 2*

If you send notice of your organization's public activities at least four months in advance, we will publish them as space permits. Please send them to BYTE (Events and Clubs), One Phoenix Mill Lane, Peterborough, NH 03458.

CLUBS

Coastal Area Atari Users' Group and BBS, David E. Warner, P.O. Box 5098, Biloxi, MS 39534; BBS: (601) 388-3490.

Amygdala, newsletter of the Mandelbrot Set; Box 219, San Cristobal, NM 87564.

Fourth Generation (+), newsletter for SQL and expert system users; Performance Computing Inc., 25 East Washington St., Suite 1500, Chicago, IL 60613, (312) 984-0431.

Ada Information Clearinghouse Newsletter, 3D139 (1211 Fern St., C107), The Pentagon, Washington, DC 20301-3081, (703) 685-1477.

North American Amiga Users Group and BBS, Box 376, Lemont, PA 16851, (814) 237-5511; BBS: (814) 339-6042.

Tugboat newsletter, Technical and User Groups Network (TUG-NET), P.O. Box 705, Van Nuys, CA 91408-0705.

TI PPC Notes, newsletter of the TI Programmable Calculator Club; P.O. Box 1421, Largo, FL 34294.

Business Software Users Group, 2252 Main St., Suite 15, Chula Vista, CA 92011, (619) 423-0538.

ACCumulator, newsletter of the Amateur Computer Club; Andy Leeder, Membership Secretary, Church Farm, Stratton St. Michael, Norwich NR15 2QB, U.K.

New York Personal Computer Inc. (NYPC) user group, Suite 614, 80 Wall St., New York, NY 10005, (212) 829-5534.

Pasadena Commodore Computer Club (PCCC), P.O. Box 1163, Arcadia, CA 91006, (818) 447-2212.

CADalyst, journal for AutoCAD users; P.O. Box 282, 810 West Broadway, Vancouver, BC, Canada V5Z 4C9.

Adam User's Group of San Diego County, 868 North 2nd St., Suite 242, El Cajon, CA 92021, (619) 445-2400.

First Rochester Osborne Group (FROG), Jim McCollum, 321 Executive Office Building, Rochester, NY 14614, (716) 232-7272. ■

IBM's new 2,400 bps PC Modems give you an easy choice:

Either



Stand-alone.
The IBM 5842
2,400 bps Modem.

Either way, you can't go wrong.

With IBM's new modems and a personal computer you can tap into information at a very impressive 2,400 bits per second (bps).

That translates into a binary file transfer speed of nearly 13 K characters per minute—or over six pages worth. Now imagine the impact that can have on your long distance telephone bill.

But these new modems aren't just fast, they're also versatile. They can both send and receive data asynchronously at speeds ranging from 2,400 bps down to 75 bps.

Both modems are compatible with the popular "AT" command set, as well as the IBM command set. And they have been tested for compatibility with leading PC communications software such as Crosstalk™ XVI, Microsoft® Access, Kermit, Smartcom® and Smartcom II.®

or



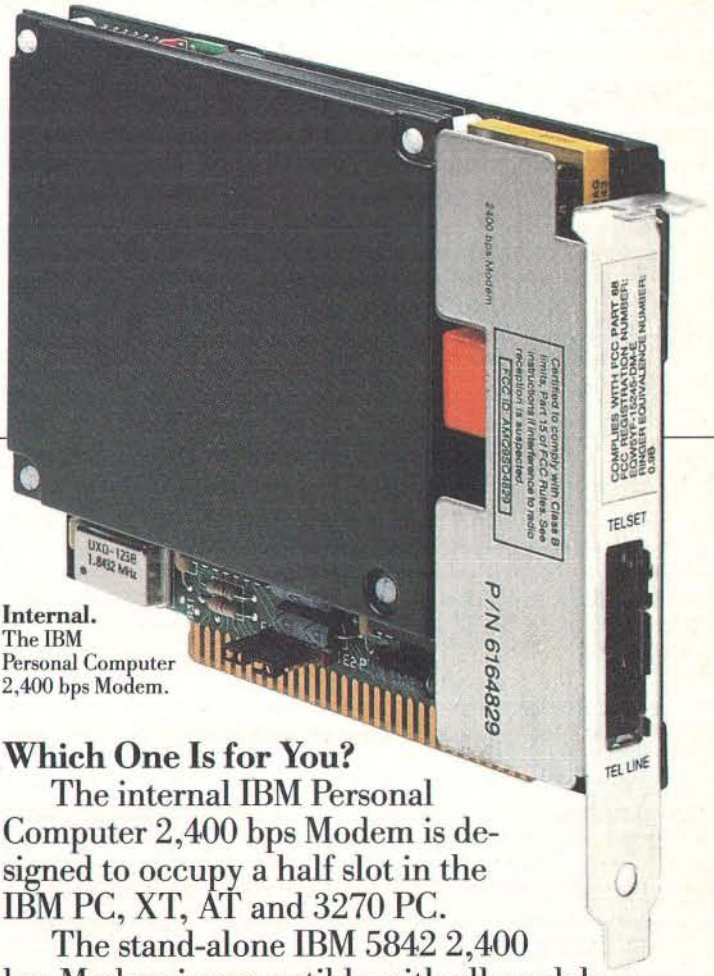
The Automatic Modems

These modems feature Automatic Adaptive Equalization at 2,400 and 1,200 bps—which means they will continuously fine-tune themselves to compensate for changes and noises on the telephone line. The result is, you can receive data over a wider range of telephone line conditions.

Both modems also feature automatic or manual answering and dialing. They'll automatically switch to pulse dialing if tone dialing doesn't work. They have automatic redialing. And once a connection is made, automatic speed detection. They also have automatic detection of a voice or a failed call.

A Modem with a Memory of Its Own

The stand-alone IBM 5842 2,400 bps Modem offers some additional features. It can also send and receive data synchronously at speeds of 2,400 bps or 1,200 bps. You'll find extensive "Help" menus. A dial directory for 20 phone numbers. A log-on directory for five log-on sequences. A built-in pattern generator for self testing. Diagnostics implemented from the front panel as well as from the computer keyboard. And a complete array of LED Status Indicators to give you a quick visual check on what's happening.



Internal. The IBM Personal Computer 2,400 bps Modem.

Which One Is for You?

The internal IBM Personal Computer 2,400 bps Modem is designed to occupy a half slot in the IBM PC, XT, AT and 3270 PC.

The stand-alone IBM 5842 2,400 bps Modem is compatible with all models of IBM Personal Computers. And, in addition to the features mentioned above and its internal power supply, the significant difference is that a stand-alone modem can be moved from PC to PC more easily than an internal modem.

If you feel that 2,400 bps is more modem than you need, we also offer the stand-alone IBM 5841 1,200 bps Modem, and the internal IBM Personal Computer 1,200 bps Modem.

For the Authorized IBM PC Dealer nearest you—or for free literature on the IBM family of PC Modems—call 1 800 IBM-2468, Ext. 104/EM. Or you can contact your IBM marketing representative.

IBM®

Crosstalk is a trademark of Microstuff, Inc. Microsoft is a registered trademark of Microsoft Corp. Smartcom and Smartcom II are registered trademarks of Hayes Microcomputer Products, Inc.

ASK BYTE

Conducted by Steve Ciarcia

Big-Screen Turbo

Dear Steve,

I am looking for software that will allow me to define screens of 132 columns by 80 rows in Turbo Pascal. I would be running this application on a WYSE-700 graphics monitor. I checked with Borland, Wyse, and most of the companies that sell Turbo Pascal screen generators. None was able to help me or could tell me how to do it myself in Turbo Pascal. Do you have any ideas?

Koenraad Lecot
Los Angeles, CA

As I understand Turbo Pascal, it uses the PC's BIOS to handle most of the work of putting characters on the screen. Therefore, you'd have to find a way to persuade the BIOS to handle the additional columns and rows.

Unfortunately, the BIOS was never designed to handle anything other than 80 by 25 and 40 by 25 displays. As witness to this fact, the IBM EGA has to provide an alternate screen-print routine in the EGA's BIOS just to handle the new 80 by 43 format.

If you wrote a set of "external" assembler routines (Pascal would most assuredly be too slow for this) that handled the screen output, you could call them from within Turbo. These new routines would have to duplicate all of the functions found in ClrScr, Write, Writeln, *and so forth, as well as the character generation required to build the output in display RAM. This is not a trivial project.*
—Steve

Put This Amiga Under Your Tongue

Dear Steve,

I would like to use my Amiga as a biofeedback training device. Is there a simple circuit that could connect through the joystick ports as a sensitive electronic thermometer? My thought is that the Amiga joystick ports have analog-to-digital converters built in, just like the Commodore 64. Normally, the ADC is used to read the potentiometer of a game paddle. I'd like to use the ADC to input the values from the temperature-reading circuit. The joystick ports also have a 5-volt power source of up to 150 milliamps. I could use this to power the interface.

It seems that, to be an effective training device, such a circuit would have to be sensitive to a tenth of a degree Fahrenheit. Is such a circuit possible?

J. Eric Chard
Seattle, WA

It should be possible to measure temperature using the joystick port of your Amiga. The hardware supports variable-resistor-type joysticks, although switch-closure-type joysticks (for example, the kind used with the Atari 400/800 series) are more often used with the Amiga.

The simplest way to implement your temperature-reading circuit is with a temperature-dependent resistor (TDR), also known as a thermistor. These devices, available from sources such as Digi-Key (P.O. Box 677, Thief River Falls, MN 56701-9988, (800) 344-4539), vary resistance with temperature. If you tie one lead to +5 volts and the other to a potentiometer input, the computer would be able to read a value whose magnitude varies with temperature.

You will probably have to experiment extensively in order to determine the best resistance-category thermistor to use with your particular system. A device with a room temperature (25° Celsius) resistance of about 30,000 to 50,000 ohms would be a good starting point for experiments.
—Steve

Multiple Hard Disks

Dear Steve,

I plan to replace my present computer with an IBM PC AT (or one of the compatibles) equipped with a hard disk. I have noticed that you can purchase such a computer with a hard disk already installed or add the hard disk yourself and possibly save some money. Also, I have noticed that available hard disks have various access times, with those having the smaller access times costing more. Can you provide some guidance concerning the relationship of hard disk access time and overall operational speed of the computer?

I realize that when you have a computer with a hard disk, you need some way to back up all that data. Most tape backup systems cost about as much as a hard disk, which brings up the possibility of using a second hard disk purely as a backup device for the first. Since I have never read or heard of anyone doing this, I wonder if you know of any reason why it wouldn't be practical. I have no great concern about the risk of keeping the backup in the same room with the original; I need a backup only to recover in case of a crashed disk. However, in case the computer does not have room or sufficient power for two hard disk drives, I might like to save desk space by locating the backup drive in an adjacent room. Is there any reasonable way to run the control and data signals for this backup drive a distance of, say, 30 feet?

James G. Barr
Littleton, CO

To answer your first question: There is no absolute relationship between hard disk access time and the overall operational speed of the computer other than that, in general, the faster the access time, the more likely that computer throughput will be increased in disk-intensive applications. For example, a system with a 30- to 40-millisecond hard disk will perform a disk-based sort program faster than the same system with an 85-ms hard disk, though not necessarily twice as fast. On the other hand, CPU-intensive tasks (such as recalculating a spreadsheet) would not be any faster, though saving or loading a spreadsheet would be.

In general, XT-style machines use a hard disk with a 60- to 90-ms access time, while AT-style machines use 30- to 40-ms hard disks (though they can use disks that are slower as well).

continued

IN ASK BYTE, Steve Ciarcia answers questions on any area of microcomputing. The most representative questions received each month will be answered and published. Do you have a nagging problem? Send your inquiry to

Ask BYTE
c/o Steve Ciarcia
P.O. Box 582
Glastonbury, CT 06033

Due to the high volume of inquiries, we cannot guarantee a personal reply, but Steve and the Ask BYTE staff answer as many as time permits. All letters and photographs become the property of Steve Ciarcia and cannot be returned.

The Ask BYTE staff includes manager Harv Weiner and researchers Eric Albert, Bill Curlew, Ken Davidson, Jeannette Dojan, Jon Elson, Roger James, Frank Kuechmann, Dave Lundberg, Tim McDonough, Edward Nisley, Dick Sawyer, Andy Siska, Robert Stek, and Mark Voorhees.

COPYRIGHT © 1987 STEVEN A. CIARCIA. ALL RIGHTS RESERVED.

MICROSOFT LANGUAGES NEWSLETTER VOL. 2, NO. 3

News about the Microsoft Language Family

Tracing through User Libraries with Microsoft® QuickBASIC

Large programs are easier to maintain and debug if they are divided into smaller, more manageable parts. These units are called modules and may contain up to 64K of subprograms. You may separately compile subprograms with Microsoft QuickBASIC and build user libraries of these BASIC subprograms as well as assembly language routines. These user library routines can be used over and over again and are linked into your BASIC programs as needed.

Debugging these user libraries is made very simple with the built-in debugger in Microsoft QuickBASIC. QuickBASIC's built-in Debugging mode allows you to control the rate of program execution and the number of source lines displayed during execution. The Debugging mode is activated when the TRON statement is executed and is turned off with the TROFF statement. You can activate the Debugging mode for part or all of a source file. The Debugging mode has three "submodes": Step, Trace and Animate.

When you debug your BASIC programs that call subprograms contained in user libraries, Microsoft's QuickBASIC Debugging mode lets you trace through the user library routines when you activate the Trace mode. This mode traces program execution one line at a time like the Step debugging mode but you may also trace program execution through subprograms and user-defined functions. If you call any assembly language routines in your main program, the Trace mode will not trace through each line of the assembly routine but will trace the entire routine as a whole. Because the built-in debugger allows you to display both the source code and the output screen, you may observe the program execute while seeing the output.

Support Available for Microsoft Language Products

Once you purchase your Microsoft language product, a number of support services are available to you. If you have any problems with your product, you may call the Microsoft Product Support Hotline at (206) 882-8089 for assistance. A Product Support Representative will try to help you find a solution. In addition, Microsoft provides technical assistance on some electronic bulletin boards, such as CompuServe®.

If you are a software developer who needs in-depth information, you may purchase Microsoft DIAL, an integrated set of on-line services. You can gain access to information on the DIAL bulletin board (which lists answers to frequently asked technical questions and provides information on new products, bug lists, seminars, and many other topics), and if the answer you are looking for is not on the bulletin board, you can electronically submit technical assistance requests (TARs) directly to Microsoft's support organization. Contact Linda McCarty at (206) 882-8080 for an application form and additional information on DIAL.

Filling out and sending in your product registration card is very important. It will allow you to receive notices about new versions and enhancements to your Microsoft product. The update notices let you know about the enhancements and instruct you on how you may receive the updated version. If you are in the market for a language product, you may receive useful information from this newsletter; you may also purchase a subscription to our Microsoft System Journal that contains technical articles on our languages and operating systems/environments. Microsoft Consumer Response can help you by sending you data sheets and other information such as the Language Support Directory (for available third-party libraries that support Microsoft languages).

For more information on the products and features discussed in the Newsletter,
write to: Microsoft Languages Newsletter
16011 NE 36th Way, Box 97017, Redmond, WA 98073-9717.
Or phone:
(800) 426-9400. In Washington State and Alaska, call (206) 882-8088. In Canada, call (416) 673-7638.

Latest DOS Versions:	
Microsoft C Compiler	4.00
Microsoft COBOL	2.10
Microsoft FORTRAN	4.00
Microsoft Macro Assembler	4.00
Microsoft Pascal	3.32
Microsoft QuickBASIC	2.01

Microsoft is a registered trademark of Microsoft Corporation. CompuServe is a registered trademark of CompuServe, Inc.

Look for the Microsoft Languages Newsletter every month in this publication.

Many people do use a second hard disk as a backup unit just as you suggest. In fact, I am beginning to see products specifically for this purpose. However, due to the nature of the electrical signals going to and from the hard disk, it is not possible to locate the backup drive more than a few feet from the computer—5 feet perhaps, but not 30 feet. If you cannot fit a second drive within your machine, then a "hard-card" type hard disk or a standalone unit with its own power supply would be good bets. Most hard disk controller cards can handle two drives, but consult a dealer for a particular machine to be sure.—Steve

dIRECT dBASE to dISK

Dear Steve,

I have an IBM PC with two floppy disk drives and a hard disk. I need to be able to redirect printer output to a file on a floppy disk. Do you know how to do this?

I am using dBASE III to write material specifications. I am using the full-screen edit commands to create the body of a form; data is merged into the form only at printing time. I am fairly certain, after talking to an Ashton-Tate technical representative, that there is no way to redirect dBASE III printer output to a file. I have also perused the PC-DOS 2.10 manual and there doesn't seem to be any way to redirect output through the DOS. Any help you can give would be appreciated.

Paul Knutson
Denver, CO

Without knowing exactly how you are trying to accomplish printer redirection, it is difficult to answer you specifically. I realize that in dBASE III, full-screen edit or @ SAY commands cannot be redirected to a file with the SET ALTERNATE TO <filename> *command. I assume that this is what you are attempting. This problem has been addressed (though not consistently or reliably) by some public domain programs from Mark DiVecchio, 9067 Hillery Dr., San Diego, CA 92126, (619) 566-6810. He will send you the programs if you send him a PC-DOS–formatted floppy disk and a self-addressed stamped floppy disk mailer.*

Another program that may be of help is PrintQ, from Software Directions Inc., 1572 Sussex Turnpike, Randolph, NJ 07869, (800) 346-7638. A call to them may be able to answer your question specifically.

If neither of these two suggestions works out, is it possible to reprogram the part of your system that is using the full-screen edits? That is, set up a temporary file to hold the information and merge it with the rest of your text so that a SET ALTERNATE *command would redirect the information to a file. If this sounds at all feasible, a good dBASE III consultant might be able to help.*—Steve

Exceeding the Speed Limit

Dear Steve,

I have recently installed a math coprocessor (8087-2) and 20-megabyte hard disk unit in my Panasonic Exec. Partner FT-70 computer. This computer has two clock options: normal 4.77 MHz and fast 7.16 MHz.

Since I have made the additions to my computer, I have started having problems. When I run the computer in the fast-speed mode, the moment a program accesses the hard disk, the system locks up and cannot be restarted unless I switch off the power to the computer and reboot. This doesn't happen if I operate the computer (a) in the normal 4.77-MHz mode, (b) in the fast mode but using only the floppy disk drive, or (c) in the fast mode after I have physically removed the math coprocessor. (The problem remains if I disable

continued

CMOS Little Board/PC™

BOOTS PC-DOS/MS-DOS

SCSI BUS INTERFACE (HARD DISK, ETC)

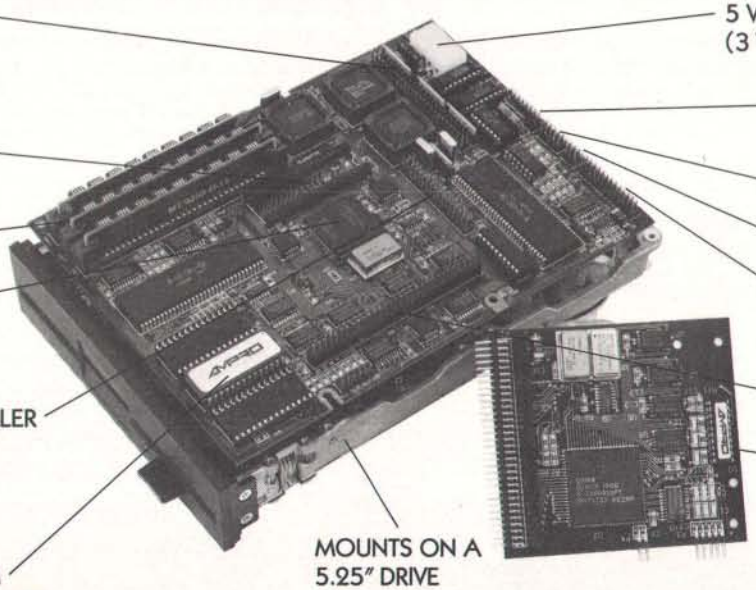
MATH CO-PROCESSOR OPTION

768 K RAM

POWERFUL V40 CPU

FLOPPY DISK CONTROLLER (3.5″/5.25″, 360 K/720 K, 1.2 MB)

UP TO 128 K EPROM/RAM/NOVRAM BATTERY BACKED RT CLOCK



MOUNTS ON A 5.25″ DRIVE (5.75″x8″x1″)

5 VOLT ONLY OPERATION (3 WATTS!)

2 RS232C SERIAL PORTS

SPEAKER PORT

KEYBOARD PORT

PARALLEL PRINTER PORT

PC BUS

4 MODE VIDEO CONTROLLER OPTION (MONOCHROME, HERCULES, CGA, HIGH RES CGA)

MS-DOS Microsoft Corp.

AMPRO COMPUTERS, INCORPORATED

67 East Evelyn Avenue • Post Office Box 390427, Mountain View, CA 94039 • (415) 962-0230 • TLX 4940302

Inquiry 21

Programming Ease for Scientific & Engineering Applications

No matter what your level of programming expertise, if you write your own programs for engineering, science, or statistics applications, Wiley Professional Software's technical programming tools enable you to save programming time and development costs. These tools allow you to generate dependable, accurate and error-free code, quickly and easily.

NEW! Statistics Subroutine Libraries

STATLIB series, developed by PSI/Systems, is a one-stop source for Time Series and Graphics data analysis. These two new subroutine libraries are ready to address your statistics programming problems. STATLIB.TSF covers routines in forecasting and analysis of time-based data. Generalized linear regression models, ARIMA models, survival analysis, econometric forecasting, exponential forecasting, and spectral analysis are just a few of the routines which will prove invaluable to statisticians and to programmers, engineers, and scientists who use statistics.

STATLIB.GL is a statistical *graphics* library with subroutines for Box-Jenkins identification, scatter graphs, curve-fit graphs, contour maps, axonometric plots and much more, including a library of GKS device drivers.

Economists and marketing and financial forecasting professionals will find these routines invaluable in their day to day work. And they are a must for every scientist and engineer who programs in FORTRAN. These subroutine libraries give you all the benefits of a complete package and the added advantages of allowing you to quickly and easily customize *your* program for *your* needs. SOURCE CODE INCLUDED.

STATLIB.TSF: Time Series Analysis & Forecasting Subroutine Library $295
STATLIB.GL: Statistical Graphics Subroutine Library $295

Microsoft and IBM Professional FORTRAN versions available.

The Classic Subroutine Library for BASIC, FORTRAN, and C Programmers

MICROSOFT FORTRAN Library. $175
C Language Library $175
BASICA Library. $125
IBM Professional FORTRAN Library $175

NEW! 50 More FORTRAN Library

The *50 MORE FORTRAN* Library, developed by Peerless Engineering Service, offers a collection of subroutines and utilities previously unavailable in our FORTRAN Library. Included are pretested and precompiled subroutines covering such areas as Matrices, Polynomials, Differential Equations, and Numerical Analysis (including FFTs), plus utilities for more effective screen handling. SOURCE CODE INCLUDED.

MICROSOFT FORTRAN or IBM Professional FORTRAN version $125

NEW! SWAP Conversion Software

SWAP is a high-speed software program for the IBM-PC® that allows users to quickly and easily switch from one word processing file format to another. You don't need to own or operate the program you are converting from—just the program you are converting to.

Now you can SWAP documents to and from any of these popular word processing programs: WordStar®, WordStar 2000®, Multimate®, WordPerfect™, DisplayWrite® 3 (DCA Revisable Format), and ASCII . . . . . **only $79.95**

SPECIAL FEATURES:

- *Batch processing* (allows you to convert more than one file at a time)
- *Lightning fast* (five times faster than competitive products)
- *Reliable* (guaranteed to convert all possible elements)
- *Easy to use* (does not require any previous computer knowledge)
- More *thorough* and *accurate* than conversions that are already built into popular word processing programs
- A *library approach* which allows easy and automatic access to the appropriate conversion
- *Updates* for new versions

WordStar and WordStar 2000 are registered trademarks of MicroPro International Corporation. MultiMate is a registered trademark of MultiMate International, an Ashton-Tate company. WordPerfect is a trademark of Satellite Software International. DisplayWrite is a registered trademark of International Business Machines Corporation.

To order any of Wiley's scientific and engineering programming tools with your VISA or MasterCard, call: 212-850-6788 or write:

wiley™ PROFESSIONAL SOFTWARE
THE TECHNICAL SOFTWARE SOURCE

Wiley Professional Software
John Wiley & Sons, Inc.
Attn: D. West
605 Third Avenue,
New York, NY 10158
Dealer inquiries invited

PC NETWORK



America's Favorite Business Software

for the IBM and compatibles

LOTUS 1-2-3 **$285.00***

DBASE III+ **$375.00***

WORD PERFECT **$185.00***

Borland *Reflex*	**$80.00***
Borland *Turbo Pascal w/8087 & BCD Ver. 3.0*	**53.00***
Borland *SuperKey*	**38.00***
FGS *Fastback*	**85.00***
Microsoft *Word Latest Version 3.1*	**229.00***
Microsoft *Quick Basic*	**54.00***
Microsoft *Windows*	**51.00***

Your #1 Source for Chips

64K IBM™ Memory Expansion Kit
200ns/Set of 9
$7.75*



64K *Memory Upgrade Kits (9 Chips)*	**$7.75***
256K *Dynamic Ram Chips*	**ea. 2.90***
128K *AT Mother Board Chips*	**ea. 3.90***
Intel *8087 5Mhz Co-Processor*	**105.00***
Intel *8087 8Mhz Co-Processor*	**161.50***
Intel *80287 5Mhz/8Mhz*	**197.00***

All Chips are Guaranteed for Life

TOLL FREE (800) 621-SAVE

Inquiry 223

(Orders-Membership and Advice!)
In Illinois call (312) 280-0002
Your Membership Validation Number BB37

You can validate your membership number and, if you wish, place your first money-saving order over the phone by using your VISA, MASTERCARD or AMERICAN EXPRESS.

Our knowledgeable sales consultants are on duty:

MON.-FRI. (CST) SATURDAY
8am-7pm 9am-5pm

PERSONAL COMPUTER NETWORK
320 West Ohio
Chicago, Illinois 60610
FOR CUSTOMER SERVICE AND ORDER STATUS
CALL: (312) 280-1567

MEMBERS PAY WHOLESALE AND GET 14-30 DAY

BUSINESS SOFTWARE

(Please add $2.50 shipping and handling for each title ordered from below.)

Borland *SideKick (UnProtected)*	**$45.00***
Borland *Turbo Pascal w/8087 & BCD Ver. 3.0*	**53.00***
Breakthrough Software *Time Line 2.0*	**220.00***
Central Point *Copy II PC*	**20.00***
Computer Associates *Supercalc IV*	**239.95***
Computer Associates *Super Project Plus*	**239.95***
DAC *Easy Accounting*	**39.80***
Enertronics *Energraphics 2.0*	**280.00***
Funk Software *Sideways*	**32.00***
Harvard *Harvard Total Project Manager*	**250.00***
Hayes *Smartcom II—New VT 100 Emulator*	**68.00***
Living Videotext *Think Tank*	**87.00***
MicroPro *Wordstar 2000*	**210.00***
MicroPro *Wordstar 2000+*	**259.00***
MicroRim *RBase 5000*	**215.00***
MicroRim *RBase 5000*	**258.25***
Microsoft *C Compiler*	**230.00***
Microsoft *Multiplan*	**98.00***
Monogram *Dollars and Sense*	**85.00***
Multimate *Advantage*	**270.00***
Multimate *Multimate Latest Version*	**230.00***
Nantucket *Clipper DBase III Compiler*	**350.00***
Norton *Commander*	**36.00***
Norton *Norton Utilities 3.1*	**43.00***
Software Publishing *PFS: Professional File*	**132.00***
Software Publishing *PFS: Professional Write*	**105.00***
Software Publishing *PFS: Report*	**64.00***
Software Publishing *PFS: Write, File, Graph*	**68.00***

†RENT BEFORE YOU BUY—Members are eligible to join the NETWORK'S Business and Game Software Rental Libraries to evaluate products for a full 14 days (Regular Membership) or 30 days (VIP Membership) to see if they meet your needs. And the NETWORK'S rental charges are far less than other software rental services—JUST 20% OF THE MEMBER WHOLESALE PRICE. **We feature over 1,000 available titles in IBM/Apple/Mac**

PC NETWORK–THE NATION'S LARGEST COMPUTE

PC MAGAZINE

"THE™ PC+ is well built and has enough company support behind it to make it a very attractive alternative to higher priced competition."



"THE's bottom line? The PC+ is a highly compatible clone worthy of consideration..."

PC WORLD

"...the unit became the preferred computer in our office, which has several name brands as possible alternatives..."

Computer Dealer

THE™ PC+
100% IBM Compatible
256K/w 360K Drive, Turbo Speed, AT Style Keyboard
$444.00*
w/640K $469.00*

PC NETWORK MEMBERSHIP APPLICATION

YES! Please enroll me as a member in the PC NETWORK™ and send my catalog featuring thousands of computer products, all at just 8% above DEALER WHOLESALE PRICES. I will also receive "THE PRINTOUT", a special periodic update on merchandise at prices BELOW even those in my wholesale catalog and all the other exclusive, money-saving services available to Members. I am under no obligation to buy anything. My complete satisfaction is guaranteed.

Please (✓) all boxes that apply: **B37**

•Basic Membership	**1 Year**	**2 Year**
With 14 Days Rental	**$8** ☐	**$15** ☐
Business Software Rental Library	**$25** ☐ add'l. per year	
Games Software Rental Library	**$10** ☐ add'l. per year	
•Special V.I.P. Membership	**1 Year**	**2 Year**
With 30 Days Rental	**$15** ☐	**$25** ☐
BOTH Business and Game Software Rental Libraries	**$30** ☐ add'l. per year	

☐ Bill My Credit Card: ☐ VISA ☐ MasterCard ☐ American Express

Account Number:

Exp. Date: mon. _____ yr. _____

☐ Check or Money Order Enclosed for $_____

Name _____

Address _____ Apt. No. _____

City _____ State _____ Zip _____

Telephone: ( ) _____

My Computer(s) is: ☐ IBM ☐ IBM XT ☐ IBM AT
☐ Apple II ☐ Macintosh Other _____

Signature _____
(Signature required to validate membership)

Copyright 1986. PC NETWORK, INC.

Save on Famous Name Printers



EPSON FX-286e
132CPS/200CPS LQ
$490.00*

PRINTERS

Citizen *MSP-10 160CPS/80COL/Fric + Trac*	**$259.00***
Citizen *MSP-15 160CPS/132COL/Fric + Trac*	**340.00***
Citizen *Premiere-35 35CPS Daisywheel 15"*	**420.00***
Epson *EX-800 300/60CPS 132COL Par/Ser*	**470.00***
Epson *EX-1000 300/60CPS 132COL Par/Ser*	**569.00***
Epson *FX-85 160/35CPS 10" Par*	**345.00***
Epson *FX-286e 200/40CPS NLQ*	**490.00***
Epson *LQ-800 180/60CPS 10" 24 Pin Par/Ser*	**499.00***
Epson *LQ-1000 180/60CPS 15" Pin Par/Ser*	**687.00***
Epson *LQ-2500 324/108CPS 24 Pin Par/Ser*	**990.00***
Epson *LX-86 120/16CPS 8.5" Par w/NLQ*	**220.00***

• 10 DAY HARDWARE RETURNS • CATALOG

(No Questions Asked, If You Don't Like It, Return It) (30,000 Items Listed)

PC NETWORK

PLUS 8% OR LESS SOFTWARE RENTALS†

GAMES & EDUCATIONAL SOFTWARE

(Please add $2.50 shipping and handling for each title ordered from below.)

Broderbund *The Print Shop*	$30.00*
Broderbund *The Print Shop Library, Disk 1 or 2*	21.00*
Broderbund *Toy Shop*	34.50*
Davidson *Math Blaster or Word Attack*	23.00*
Electronic Arts *Amnesia*	29.97*
Electronic Arts *Music Construction Set or One on One*	15.97*
Infocom *Hitchhikers Guide, Ballyhoo*	20.00*
Infocom *Leather Goddesses of Phobos*	20.00*
Infocom *Zork II, Zork III*	22.00*
Microprose *F-15 Strike Eagle or Silent Service*	18.50*
Microsoft *Flight Simulator Vers. 2*	27.00*
Mindscape *View to A Kill/First Blood Pt. 2/The Mist*	21.00*
Mouse Systems *PC Paint + -Turn Your PC into a Color Macintosh*	59.95*
Scarborough *MasterType*	19.75*
Sierra On-Line *Black Cauldron*	21.25*
Sierra On-Line *King's Quest II*	24.75*
Spectrum Holobyte *GATO*	18.00*
Spectrum Holobyte *Telestar Level 1, Orbitor*	24.00*
Spinnaker *Alphabet Zoo, Kinder Comp., Face Maker*	15.97*
Spinnaker *Delta Drawing or Most Amazing Thing*	20.75*
Springboard *Certificate Maker*	31.00*
Springboard *Newsroom*	29.97*
Springboard *Newsroom Pro*	64.50*
Sublogic *Night Mission Pinball*	20.00*
Sublogic *Jet*	27.50*

***PC NETWORK MEMBERS pay just 8% above the wholesale price, plus shipping.**
All prices reflect a 3% cash discount. Minimum shipping is $2.50 per order. International orders call for shipping and handling charges. Money Orders, company and personal checks please allow 10 working days to clear. All prices are subject to change without notice. All products subject to availability.

TM—Registered trademarks of Apple/Ashton-Tate/AST/Compaq/ Epson/Hayes/IBM/Intel/Lotus/Macintosh/Microsoft

CALL FOR PRICING ON APPLE PRODUCTS

Big Values on Computer Monitors

MONITORS

Amdek *310A Amber TTL Monitor*	$130.00*
Amdek *Color 600 Hi Res RGB Monitor*	365.00*
Amdek *Color 722 Enhanced EGA Monitor*	424.00*
Amdek *Color 725 13" Ultra Hi Res*	479.00*
Magnavox *14" Color RGB 640x240 Monitor*	250.00*
Magnavox *12" TTL Amber Monitor*	79.00*
Magnavox *14" EGA Monitor w/tilt*	435.00*
Magnavox *14" Multi-mode*	489.00*
Princeton *HX-12 Color RGB Monitor*	369.00*
Princeton *HX-12E Hi Res RGB/EGA Monitor*	445.00*
Princeton *Max-12 12" Amber TTL*	138.00*
Taxan *650 Hi Res RGB 720x400*	470.00*
Zenith *ZVM-1240 12" Amber Hi Res TTL*	140.00*



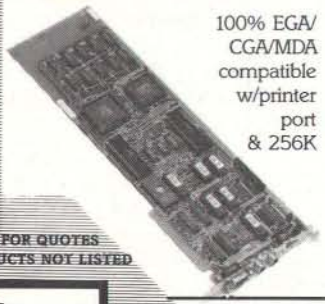
NEC Multisync Monitor

$530.00*

Your #1 Source for Add In Boards

THE™ EGA Graphics +

$220.00*



100% EGA/ CGA/MDA compatible w/printer port & 256K

VIDEO BOARDS

Hercules *Color Card w/Parallel Port*	$135.00*
Hercules *Monochrome Graphics Card*	162.00*
Paradise *Autoswitch EGA*	336.00*
Paradise *Modular Graphics Card*	219.00*
Quadram *Quad EGA+*	323.00*
THE™ Color Card *100% IBM Compatible*	60.00*
THE™ H720 *Mono Graphics w/Parallel Port 100% Hercules Compatible!*	69.00*

MULTIFUNCTION CARDS

AST *Advantage for AT w/128K*	$325.00*
AST *Six Pak Plus w/64K*	139.00*
Orchid *Conquest 2.5MB RAM S/P/PCnet Con/Clk*	220.00*
Orchid *Tiny Turbo 286*	399.00*
THE™ Multi I/O *I/O Plus Clone Ser/Par/Game/Clock*	60.00*
THE™ Multi 384 *w/0K Ser/Par/Game Clk/Cal*	67.00*
THE™ 2MB RAMCard *Lotus™/Intel™ Specs w/0K*	99.00*

RODUCTS MAIL ORDER COMPANY CALL FOR QUOTES ON PRODUCTS NOT LISTED

The Best Buys in Disk Storage

NEW LOWER PRICE



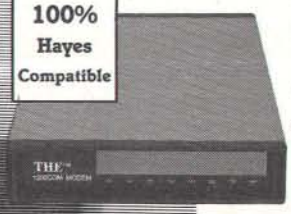
THE™ 20MB Hard Disk Kit
w/controller, cables

$347.00*

DISK DRIVES

Everex *60MB ½ Ht Int. Streaming Tape Backup*	$725.00*
IOmega *Dual 20MB Bernoulli Box w/Cntrl*	2,199.00*
IOmega *Dual 10MB Bernoulli Box w/Cntrl*	1,710.00*
PC Network *½ Ht 360K Floppy Drive*	75.00*
PC Network *10MB ½Ht Hard Disk Kit*	289.00*
PC Network *30MB AT Internal Hard Disk*	445.00*
PC Network *30MB Capacity ½Ht Hard Disk w/RLL Controller*	425.00*
PC Network *10MB ½ Ht. Int. Streaming Tape*	340.00*
PC Network *20MB ½ Ht. Int. Streaming Tape*	520.00*
Tandon *20MB Internal Discard*	435.00*
TEAC *1.2MB Add On Floppy for the IBM AT*	99.00*
THE™ 20MB *HD/20MB Tape B/U Combo Kit*	699.00*
THE™ 20MB *Hard Disk Card*	375.00*

100% Hayes Compatible



The Best Buy in Modems

THE™ 1200 COM External
1200 Baud w/auto dial, re-dial, speaker

$119.00*

MODEMS

Anchor *Lightning-1 2400 Baud ½ Card*	$282.00*
Anchor *Lightning-1 2400 Baud External*	309.00*
Hayes *Smartmodem 2400 External*	525.00*
Hayes *Smartmodem 1200B w/Smartcom II VT-100 Emulator*	315.00*
Hayes *Smartmodem 2400B Internal*	478.00*
Prometheus *2400 Baud Upgradable Modem*	329.50*
THE™ 1200 Com *Short Slot Internal Modem w/Software*	109.00*
THE™ 2400 Com *External 2400BPS*	259.00*
THE™ 2400 Com *Internal 2400BPS*	197.00*
U.S. Robotics *Courier 2400BPS External*	345.00*
U.S. Robotics *Password 1200BPS External*	180.00*



IBM™ XT BASE SYSTEM
256K System/2 360K Drives/Keyboard

$1,190.00*

IBM™ AT BASE SYSTEM
1.2 MB Floppy w/256K Hard Controller

$2,204.00*

IBM™ XT 286 System	$2,875.00*
IBM™ XT 20MB HD	$1,497.00*



COMPAQ™ PORTABLE
20MB Hard Disk/360K Drive/256K RAM

$1,800.00*

COMPAQ™ DESKPRO SYSTEM
256K CPU/1 Floppy/Hard Disk

$1,825.00*

AT&T 6300 PC CPU2/640K, 2 Floppy 1 Ser/1 Par, Mono Monitor, MS DOS, Keyboard **$1,640.00***

DS/DD DISKETTES 5¼"

BOX OF 50

.44* ea.

BOX OF 10

$7.95*

• NEWSLETTERS • 24 HOUR BULLETIN BOARD • SOFTWARE RENTALS

(Catalog Price Updates and Reviews) (10,000 Free Programs to Download) (Over 1,000 Titles in our Library)

Inquiry 247

Boost cursor speed.

Stop cursor run-on.

With all the recent hoopla over performance, it's ironic that two of the PC's ergonomic deficiencies have been overlooked — its slow cursor, and the tendency of the cursor to remain in motion (run-on) after a cursor key has been released. Finally, the solution — Cruise Control™ from Revolution Software.

Cruise Control is a new productivity tool for serious PC users. It boosts cursor speed, typically by 3-5X. It eliminates annoying cursor run-on. And it adds hands-free cursor navigation to any application.

If you use 1-2-3, Symphony, dBASE, Reflex, or Paradox, you need Cruise Control's Anti-Skid Braking. Here's what the leader of one Lotus users group said about Cruise Control:

"Once I used it, I wanted it! Excellent idea. Very practical. One of the best programs ever sent to us for review!"

If you use Word Perfect, MS-Word, Q&A, DisplayWrite, MultiMate, WordStar 2000, Framework, PC-Write, or SideKick, you need Cruise Control's Screen Runner, the high-performance, adjustable-speed cursor.

Cruise Control's namesake feature takes the drudgery out of paging through data base records, long documents, and large spreadsheets. It lets you repeat any key, hands-free — at the speed of your choice.

And there's more. A Chronometer "types" the time or date into your application at the current cursor position. The keyboard-controlled Screen Dimmer protects your privacy. The programmable Auto-Dimmer extends the life of your display screen.

Compatible with thousands of today's popular programs, including Lightning, SuperKey, and Ready!. Uses only 3K RAM. For DOS 2.0 or later. Not copy-protected. No risk, 60-day money-back guarantee.

Cruise Control™

From now until 3/31/87:

Only $29.95.

Call now to order by credit card (VISA/MC/AX):

201-366-4445

Or, mail $29.95 plus $3.50 shipping and handling to:

Revolution Software, Inc.

715 Route 10 East • Randolph, NJ 07869

Dept. 200

the coprocessor by DIP switches only.)

Any suggestions?

M. T. Basarankut
Ankara, Turkey

It sounds very much like the hard disk controller was designed to run at 4.77 MHz and you're running it beyond its limits at 7.16 MHz. The 8087 is connected to one of the DMA request lines and it may be that at the higher clock speeds the disk controller DMA goes awry. I don't have any solid proof of that, but it sounds reasonable, given your description.

These sorts of problems are almost impossible to diagnose without a full set of schematics and a pile of test equipment, so I think the only practical solution is to restrict the clock speed to 4.77 MHz. That will allow you unrestricted use of the hard disk and coprocessor, and I think you'll find that the speed is entirely adequate, particularly because the disk is much faster than floppies for I/O-intensive operations.—Steve

CIRCUIT CELLAR FEEDBACK

SB180

Dear Steve,

Although I don't have a computer yet, I intend to purchase one soon. I need it for several cataloging jobs, doing foreign language translation, some writing, plus numerous other projects including programming to customize files and reports.

I would like to program the Z80 rather than the 8088 (or any processor more complex) because my short-term memory does not serve me well (I am 73). Consequently, I am interested in your SB180 project described beginning in the September 1985 Circuit Cellar.

Could you send me the addresses of any SB180 users groups, any articles or reports other than your original project description, and the addresses of any firms other than the Micromint that package the SB180 as part of a complete hardware system? Your sophisticated but down-to-earth projects make a big contribution to BYTE. Thanks.

John D. Van Vliet
Spring Valley, NY

Thanks for your interest in the SB180. There is a national users group that publishes a monthly newsletter about the machine and its software as well as offering low-cost public domain programs for it. The address is

North American One Eighty Group
P.O. Box 2781
Warminster, PA 18974

Because the SB180's operating system is compatible with CP/M, there are literally thousands of programs available that will run on an SB180 equipped with two disk drives and a serial ASCII terminal. A variety of languages, such as BASIC, C, Pascal, FORTRAN, and assembler, are all available for the SB180 to allow you to write programs of your own design.

The SB180 circuit board is used in a number of dedicated control applications, but I believe the Micromint may be the only place offering an assembled and tested personal computer system. Micromint also offers cable sets, cabinets, and so on, if you are interested in building the system yourself.—Steve

C-128 CP/M

Dear Steve,

There has been a growing interest in CP/M among the members of our local Commodore users group. We have been wondering if the Commodore 128's CP/M mode could be improved by replacing the Z80 chip with the Hitachi HD64180 chip that you used in your SB180. The local Commodore-Amiga service dealer said it was possible.

We would like your opinion on the conversion before we start.

William E. Gary
Lafayette, LA

The HD64180 chip is compatible with the Z80 instruction set; however, it is not a pin-compatible replacement for the Z80. In addition to the additonal CPU instructions available on the HD64180, the chip also has built-in memory management units and two serial ports. Adapting the chip to your C-128 might be possible, but the amount of work involved might not be worth it.

If you and your group are serious about wanting to experiment with the Hitachi chip, you might consider either building the SB180 from scratch or buying an assembled board. Your Commodore could be used as a terminal to talk to the SB180 and in the long run you would probably spend less money than if you modified a C-128, without voiding your Commodore warranty.—Steve

Home Control

Dear Steve,

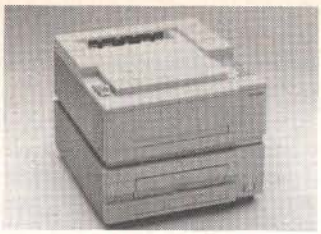
I wrote to you several years ago about a home control system that I was playing with. My system was more oriented toward laziness than most of your work, with the emphasis on control of home entertainment and X-10 switches. I have developed my system to the point that I am quite satisfied with it.

I am pleased to see commercial vendors

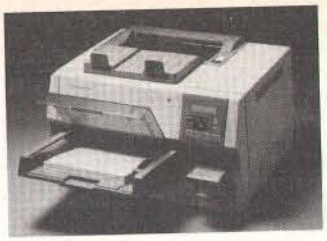
continued



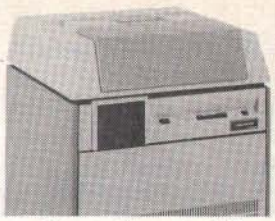
QMS-PS 800



ITT Qume ScripTEN



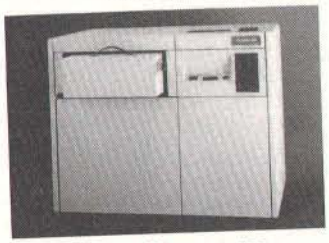
Texas Instruments OmniLaser 2108



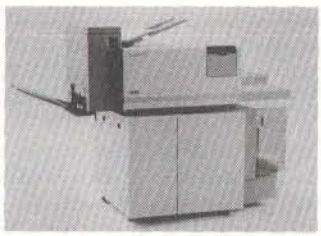
Linotype Linotronic 300



QMS-PS 2400



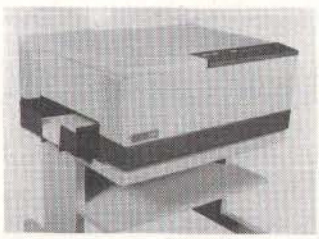
Linotype Linotronic 100



DEC PrintServer 40



NEC SilentWriter LC-890



Diconix Dijit 1/PS



Apollo Domain/Laser 26

The biggest names in desktop publishing all speak the same language.

These best selling laser printers all use POSTSCRIPT®, the page description language from Adobe Systems.

Only POSTSCRIPT can combine text, line art, even digitized photographs on the same page. That's one reason more manufacturers use POSTSCRIPT in their laser printers and typesetters than any other language.

With POSTSCRIPT you also have the option of printing from a PC, Macintosh or mini/mainframe computer. So, you select the best laser printer for your company's desktop publishing needs, without making a once-and-for-all commitment to a single vendor.

But the freedom of choice doesn't end there. Hundreds of software programs, for an assortment of operating systems, support POSTSCRIPT printers.

Plus, POSTSCRIPT is the only device independent page description language. That means a document can be designed at your office then printed professionally at a higher resolution.

So, take your pick of laser printers. Just make sure it speaks POSTSCRIPT, the language of electronic and desktop publishing.

For the name of the manufacturer's sales representative in your area, call 415-852-0271.

ADOBE SYSTEMS INCORPORATED

POSTSCRIPT from Adobe. The magic behind desktop publishing.

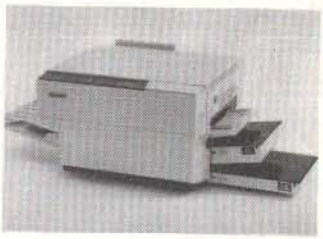
POSTSCRIPT is a registered trademark of Adobe Systems Incorporated.
Other brand or product names are trademarks or registered trademarks of their respective holders.



NBI Model 908



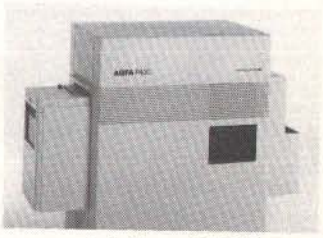
Apple LaserWriter/LaserWriter Plus



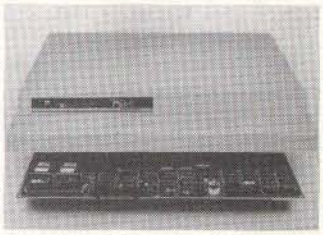
Dataproducts LZR-2665



Texas Instruments OmniLaser 2115



Agfa-Gevært P400PS



Laser Connection PS Jet

beginning to offer products that hint at home control, but I am often dismayed at their implementations. GE's universal keypad is a good example: This keypad learns the coding of up to four infrared transmitters and replaces the four keypads with one large and expensive one.

I want more than this. I want my keypad to be small, simple, and cheap. I want several of them around the house, and in some instances I'd like to replace wall switches with keypads. I want a central controller to learn the codes required by my home entertainment components and I want receivers in each room to communicate with it. I'd be pleased if that communications link could be a protocol akin to GE's Homenet over an X-10–style carrier. In the meantime, I'm using Videolink to pipe the infrared around.

How about covering some of this in future Circuit Cellar articles? In particular, a remote-control keypad and receiver connecting to a PC through a serial port would be interesting.

Also, I enjoyed your AVMUX article (February 1986). I have a similar system, but mine is more primitive. I select one input and route that to all destinations. I will use the ideas you presented in your article to allow each destination to select a different source. I do have computer-controlled attenuators on my system and find them a necessary feature. You might cover this topic sometime. The Analog Devices AD7110 digitally controlled audio attenuator would make a nice addition to the AVMUX.

Ian Smith
Laguna Beach, CA

I'm happy to hear of your successes in home control. You can be assured that there will be future Circuit Cellar articles addressing different phases of the subject. With regard to the remote keypads: You might look into the DTMF keypad units that are available from many sources. Each pad can have up to 12 (or 16, depending on the device purchased) functions and the signal can be routed over a pair of wires or used to modulate either an RF or X-10–type carrier. There are also many approaches you can take to decode the signal at the computer, the easiest being the use of an all-on-one-chip decoder interface (several are available). Once the decoded signal is in the machine, the software can take over from there.

A computer-controlled audio attenuator might be a nice addition to the AVMUX. I would suggest that you use an additonal buffer stage when utilizing this type of control on the outputs, to allow proper matching to the destination equipment.—Steve

EPROM Programmer et al

Dear Steve,

I have some questions regarding your serial EPROM programmer (February 1985) and the RS-232C monitor (April 1983). I hope you can help.

My first two questions relate to the EPROM programmer. First, how would I modify the design so that the programmer would run directly off the PC bus? It doesn't seem like it should be too much trouble, but I haven't had a chance to figure it out. Second, would it be much trouble to modify the system to handle 27256 EPROMs? I don't have the specifications for the 27256, so I can't tell.

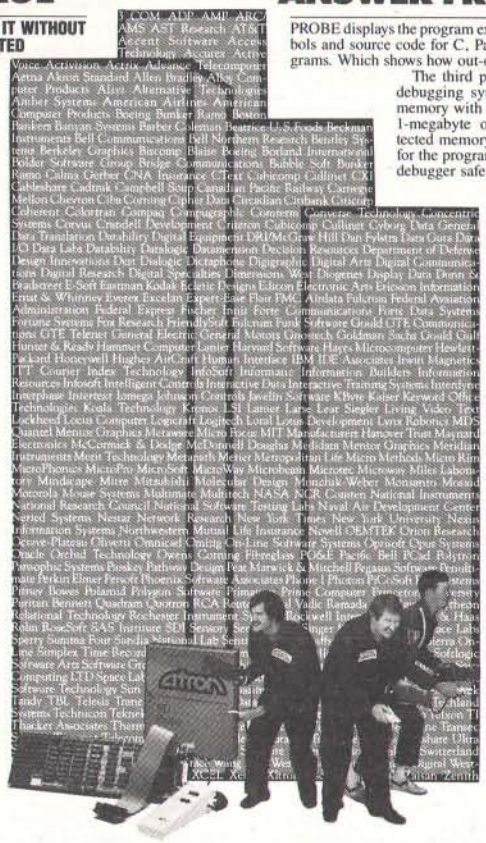
In the case of the RS-232C monitor, are there any substitutes for the MCL1303 (in figure 2)? I have not found a substitute in any of the data books I own.

Also, I would like to comment on your reply to Claudio Roland Sonnenburg in the July 1986 Ask BYTE. Mr. Sonnenburg was looking for a cross assembler in a high-level language. The Cross-8 by Universal Cross Assemblers (P.O. Box 384, Bedford, Nova Scotia, Canada B4A 2X3) is a table-based cross assembler

continued

WHAT'S THE SECRET DEBUGGING WEAPON USED BY EVERYBODY FROM BORLAND TO ORACLE? FREE 44-PAGE ANSWER FROM ATRON.

"WE COULDN'T HAVE DONE IT WITHOUT ATRON'S HARDWARE-ASSISTED SOFTWARE BUGBUSTERS."
Philippe Kahn, Borland Pres. — Larry Ellison, Oracle Pres.



This is the city saved by the Atron bugbusters. Your city. Full of wizards, with hundreds of millions of dollars invested in wringing every ounce of intelligence and performance out of your PC. It used to be plagued with the toughest software bugs known to mankind.

PLAGUES OF BIBLICAL PROPORTIONS

The first and most difficult plague was impossible to trap with software debuggers. These were carnivorous bugs which randomly overwrote programs, data, even the debugger. Nastiest were the ones that slipped in once every few hours, or changed their behavior after each new compile. Forty days and forty nights of recompiling, *trying something else*, caused many a would-be resident of the city to run screaming into the wilderness, never to be heard from again.

Second came the plague of not knowing where the program was, or where it had recently been. This compounded the first plague: How could anyone know *what* caused the random memory overwrites? Add to this random interrupts and timing dependencies, and you begin to understand *The Fear* that gripped the city.

Then came the last plague, which brought the wizards to their knees before they even started debugging. Their towering programs consumed so much memory, there wasn't enough room for their symbol table, let alone debugging software. Even if they could get past the first two plagues, this one killed their firstborn software.

ENTER THE HARDWARE-ASSISTED SOFTWARE BUGBUSTERS

The Atron solution came as a revelation: Monitor every memory reference and every instruction executed, by adding a hardware board to the AT or PC with an umbilical probe to the processor.

The result? Wham! The PC PROBE™ and the AT PROBE™ saved civilization as we know it. The first plague was cured with PROBE'S hardware-assisted breakpoint traps on reading, writing, executing, inputting and outputting. These could be done on single or ranges of addresses, and could include particular data values. All in real time. For a mere software debugger to attempt this, a 1-minute program would take 5 hours to execute.

The second plague, not knowing from whence you came, was cured with PROBE'S real-time trace memory. The history of program execution is saved on-board, in real time. Once a hardware trap has occurred, PROBE displays the program execution in detail, including symbols and source code for C, Pascal, or assembly language programs. Which shows how out-of-range pointers got that way.

The third plague, not enough room for the debugging symbol table to be co-resident in memory with a large program, was cured with 1-megabyte of on-board, hidden, write-protected memory. System memory was then free for the program, keeping the symbol table and debugger safe from destruction.

When the job of bugbusting was done, the wizards used their PROBEs as performance analyzers. So they could have both reliability *and* performance. So they could send only the best software into the field.

IF YOU AREN'T AN ATRON CUSTOMER, ODDS ARE YOU WON'T BE MAKING THE TOP-TEN LIST.

On any given week, at least nine of the top ten best-selling software packages on the Soft-Sel Hotlist come from Atron customers.

Ever heard of Borland? "Without Atron," says its president Philippe Kahn, "there wouldn't be a SideKick™, Turbo Lightning™ would be light-years away, and Turbo Prolog™ wouldn't be shipping today."

Ever use a spreadsheet? From Enable™ to Paradox™, their bugs were busted by Atron products.

Into DBMSs? Everyone from Ashton-Tate to Oracle owns at least one Atron bugbuster.

If you use a product from one of the companies in *The City*, you owe life as you know it to Atron. Our guess is that 99% of all PCs, XTs and ATs have at least one product debugged with Atron bugbusters.

FREE 44-PAGE BUGBUSTING BIBLE COULD MAKE YOU A PROPHET, AND YOUR COMPANY A PROFIT.

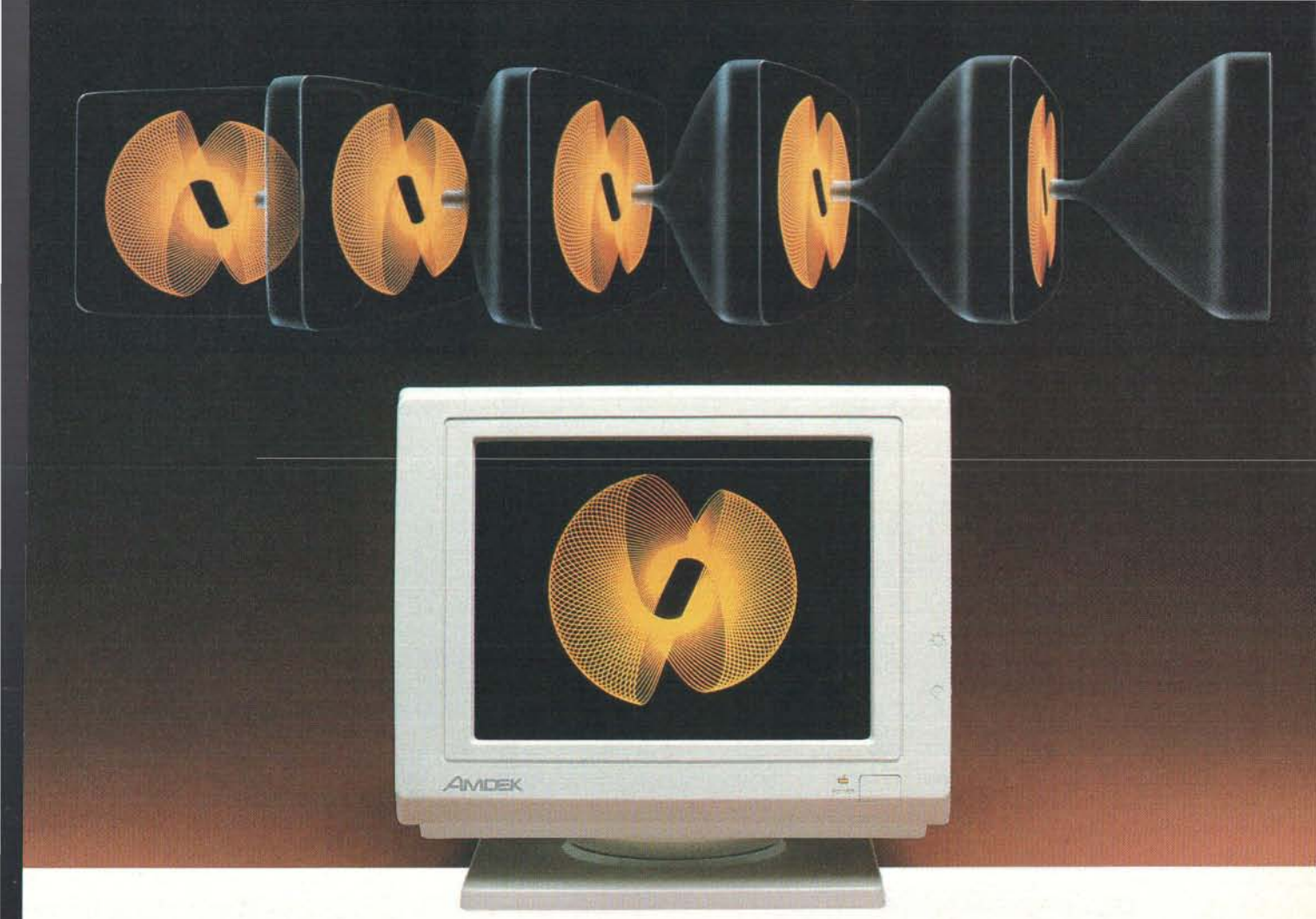
We've written a complete tutorial on state-of-the-art bugbusting. And it's yours, free for the asking. Full of examples and illustrations, it will show you how the wizards work their magic.

If you're tired of suffering the wrath of program bugs, call Atron today. You could be busting bugs, and sales records, tomorrow.

Atron
THE BUGBUSTERS
20665 Fourth Street • Saratoga, CA 95070 • 408/741-5900

Copyright © 1986 by Atron Corp. PC PROBE™ and AT PROBE™ Atron. The other fine companies mentioned throughout this advertisement own numerous trademarks. Adv. by TRBA.

Inquiry 32



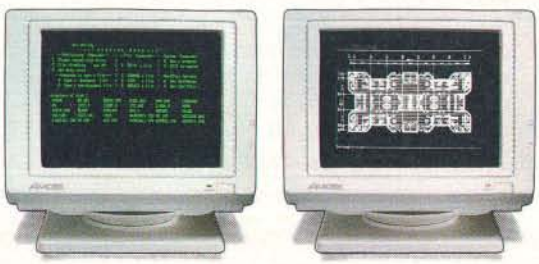
Amdek's new flat screen monitor won't leave you flat broke.

The latest in monitor technology is the flat screen. And, naturally, one of the first manufacturers to use this technology is the leading independent supplier of monitors—Amdek.

Our new flat surface monitor features a 12″ screen with dynamic focusing capabilities. And because Amdek doesn't cut corners, the 410 will provide you with consistent resolution from corner to corner. That means text will be crisp and clear no matter if it's displayed in the far upper right portion of the screen, or precisely in the middle.

What's more, depending on the software, the 410 can display up to 132 columns by 25 lines of text, giving you increased spreadsheet capability. Plus, you can choose a green, amber or white CRT—whichever is most pleasing to your eyes. A non-glare nylon mesh screen adds to easy-viewing, high-contrast display. And the attractive cabinet styling is aesthetically compatible with the IBM PC—and will actually complement any office setting. In addition, the unusually small footprint saves valuable desk space.

The Price? It won't leave you flat broke. Because the flat surface screen 410 costs less than IBM monitors. Plus Amdek's exceptional warranty makes sure that you won't be flat out of luck. It's three full years on the CRT, and two years on all other parts and labor. Our flat surface screen 410 works perfectly with the IBM XT and AT personal computers, as well as their compatible clones. So, it's the ideal monitor for many business and educational applications. With its styling, features and price, the 410 is flatly the best bargain in monitors today.



AMDEK

Clearly the finest in monitors. Inquiry 15

IBM is a registered trademark of International Business Machines Corp.

2201 Lively Blvd., Elk Grove Village, IL 60007, Phone: 312/364-1180

HARMONY COMPUTERS

2357 CONEY ISLAND AVE., (BET. AVES. T & U) BKLYN, NY 11223
800-VIDEO84 or 800-441-1144 or 718-627-1000



Commodore 1571 **$223.95**

PANASONIC 1080 i **$184.95**

STAR NX-10 **$202.95**

IBM PC XT 1 Drive **$1049.00**

"PRINTER SPECIALS"

Brother HR 20	324	IBM Proprinter	369	Siekosha Printer	164
Brother 1509	359	IBM Proprinter XL	519	Star NX-10	203
Commrex 420 IBM	699	NEC 3550	719	Star SG-10C	187
Citizen 120D	169	NEC 8850	1039	Star NP 10	169
Citizen MSP 10	269	NEC P6	429	Star NX15	324
Citizen MSP 15	369	NEC P7	599	Star SD 10	259
Citizen MSP 20	319	NEC P5 XL	1149	Star SD 15	369
Citizen MSP 25	459	Okidata 182	204	Star SR 10	387
Citizen Premier 35	429	Okidata 192+	319	Star SR 15	477
Epson LX86	214	Okidata 193 Plus	489	SR 10, SR 15 Sheetfeed	49
Epson LQ800	519	Okidata 292 w INTFC	468	Star SB 10	349
Epson LQ 1000	699	Okidata 293 w INTFC	599	Star NB 15	899
Epson FX 85	339	Panasonic KXP 1080 i	185	Silver Reed Exp 420	209
Epson FX 86E	359	Panasonic KXP 1091 i	244	Silver Reed Exp 800	619
Epson 286	459	Panasonic KXP 1092 i	312	Toshiba 341	619
Epson FX 286E	519	Panasonic KXP 3131	234	Toshiba 351 Model 2	985
Epson EX 1000	459	Panasonic KXP 3151	369	Toshiba 351C	1099
Epson LQ2500	579	Panasonic KXP 1592	379	**Toshiba 321**	**429**
	1009	Panasonic KXP 1595	479		

IBM

AT Unenhanced	2295
AT Enhanced IBM 30 Meg	
IBM PC (1) Drive	915
IBM PC XT (1) Dr	1049
4BM PC XT 286# 6MHZ. 640K 1.2 MB. 20 MB Hard Drive	2799
Fountain PCXT Turbo 256K 1 Drive	Call
IBM Monitor	219
AST Six Pack 384K	169
AST Advantage 128K	329
AST Six Pack Premium	189
Hercules Color Card	139
Hercules Monographic Plus	174
SIGMA EGA (NANOW)	199
Quad EGA+	299
Video 7 EGA+	279
Video 7 Deluxe	329
STB EGA+	259
Paradise Auto Switch	339
Multifunction Card	109
IBM Disk Drive	89
Everex EGA Enhancer	218
Everex Edge	219
Everex Graphics Pacer	189
Intel 8087-3	112
Intel 8087-2	174
Intel 80287-6	174
Intel 80287-8	289

SEAGATE

Hard Drives	
20 Meg. No Controller	329
10 Meg. w controller	369
20 Meg. w controller	379
30 Meg. w controller	429
30 Meg. AT #4038	639
40 Meg. AT #4051	760
Tandom 20 Meg. Hard Card	409

LEADING EDGE TURBO

Leading Edge Model D 512K 2 Dr Monitor 2$1149	
Leading Edge Model D 30MB w Monitor **$1649**	

MONITORS

Amdek 300 Amber	119
310 Amber	129
Color 600	359
Color 722	449
Princeton HX12	394
Princeton HX12E	469
Princeton Max 12E	144
SR12	529
Scan Doubler	159
NEC Multisync	**529**
Goldstar RGB Color	299
Goldstar TTL Amber	109

COMPAQ

Portable 256K 2-360K Compaq Drives	1499
Portable 256K 1-360K 1-20MB Hard Seagate	1899
Deskpro 640K 1-360K 1-20MB Hard Seagate	1999

COMMODORE

Commodore 128	245
1571 Drive	219
1670 Modem	119
Commodore 64C	172
1541C Disk Drive C	176
1802C	199
1902A Monitor	269
MSP 1000 Printer	219
Star SG10C	187
Amiga 256K. Dos. Mouse	699
Amiga 1080 Color Monitor	309
Amiga 256K Upgrade	139

SOFTWARE

Lotus 123 Ver. 2	289
D Base 3+	375
Framework	381
Symphony 1.2	394
Microsoft Word 3.1	254
Microsoft Windows	59
Word Perfect 4.2	196
Q & A	225
PFS Write	109
Norton Utilities	49
Microsoft Mouse	109

ATARI

130 XE	119
65 XE	89
Atari 801 Printer	179
Atari 804 Printer	189
1050 Drive	119
Atari Writer +	37
Atari 1027	119
Atari Modem 301	49
520 ST Color System	759
520 ST B & W System	629

MODEMS

Hayes 1200	354
Hayes 1200B No Smartcom	298
Hayes 1200B w Smartcom 2	328
Hayes 300	124
Hayes 2400	559
Hayes 2400B w Smartcom	499
Hayes 2400B No Smartcom	459
Micromodem 2E	125
Promethias 1200 Externa	249
Promethias 1200 Internal	149
Everex Modem Internal	119
Everex 2400 Internal	289
Hayes Smartcom 2	79

APPLE

2E Enhanced w 128K	519
Apple Drive w controller	279
Drive IIE, IIC	139
Mac 512K	1259
Mac Plus	1619
Imagewriter 2	**439**

AT&T

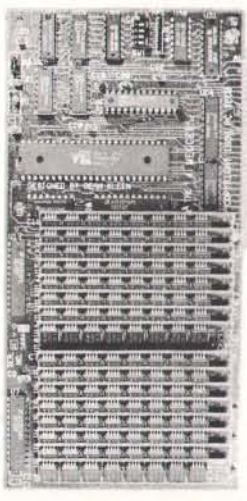
640K 1-360K Drive	1149
640K 1-360K 1-20MB Seagate Hard Drive	1539
ATT Monitor	179
ATT Dos 3.1	65

TOSHIBA PORTABLES

Toshiba 3100+	3099
Toshiba 1100+	1659

Items reflect 4% cash check discount. For your protection we check for stolen credit cards.
m.c. visa welcome. Shipping & Handling charge extra.
Price and availability subject to change without notice.

FOUR MEGABYTES
LESS THAN ONE KILOBUCK!



The PC Tech Four Megger is long on a lot of things, like memory, reliability and performance. It's short on cost, power and length. The Four Megger comes complete with software for the Lotus, Intel, Microsoft Expanded Memory Specification as well as a fast memory disk program and an extensive diagnostic program. The Four Megger works in the IBM PC/XT/AT and compatibles at 4.77 or 8 MHz. All this for $850.

Another smart idea from PC Tech.

PCtech

904 N. 6th St.
Lake City, MN 55041
(612) 345-4555

Designers of the X16 and Other Fine Computer Products

written in Turbo Pascal that can be modified to support any 8-bit processor instruction format by altering the contents of a table. It comes with tables for 12 of the more popular processors, as well as instructions for creating additional tables. It is considerably less expensive than the cross assemblers you mentioned ($100).

Lee Thalblum
Bronx, NY

By now, you've seen the new and improved serial EPROM programmer in the October 1986 Circuit Cellar. I think it will take care of all your problems!

Attaching an EPROM programmer to the PC's bus isn't quite as good an idea as you might think. It's no faster than a serial programmer, since the EPROM programming time is much longer than the data transmission time. And, worst of all, it uses up a slot in your PC.

The MCL1303 diodes limit the current through the LEDs to about 3 milliamps, regardless of the RS-232C signal level. If you don't mind having LED brightness vary, you can replace the MCL1303s with resistors. A 2.2-kilohm resistor will allow about 1 mA through for a 5-volt signal and about 3 mA at 12 volts. Don't use less than a 1-kohm resistor; this will keep the current reasonable. Don't use more than a 3.9-kohm resistor or you won't see the LED light up.

Thanks for the information on the cross assembler.—Steve

RS-232C Chip

Dear Steve,

In reviewing your design for the data encryptor in the September 1986 BYTE, I noticed that you used the MAX232 chip by Maxim rather than the more common MC1488/1489 combination. I can see the advantages of using the MAX232 chip and would like to know where I can reach the manufacturer for more information.

George A. Hadgis
Rochester, New York

The MAX232 RS-232C level converter using a single 5-volt supply is made by

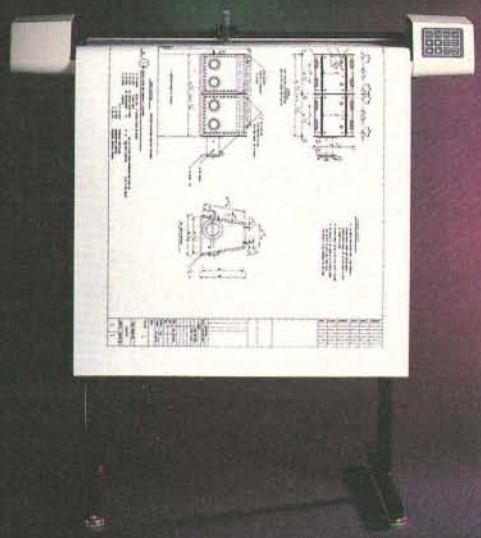
Maxim
510 Pastoria Ave.
Sunnyvale, CA 94086
(408) 737-7600

The device is described in Don Lancaster's "Hardware Hacker" column in the May 1986 issue of Modern Electronics *magazine. The MAX232 is available from*

JDR Microdevices
110 Knowles Dr.
Los Gatos, CA 95030
(800) 538-5000—Steve ■

Inquiry 226

THE NO FRILLS PLOTTER



Enter the world of professional CAD applications with Houston Instrument's low cost DMP-41/42 series plotters. These single-pen plotters give you the features you need—C and D size plots, extensive software compatibility, and proven reliability—for a very affordable no frills price of $3295.*

The DMP-41/42 series' large C and D size formats are ideal for a wide range of CAD applications, from architectural elevations to assembly drawings. And a .005 inch resolution ensures crisp drawings on a variety of media—paper, matte film, or vellum.

Inquiry 137

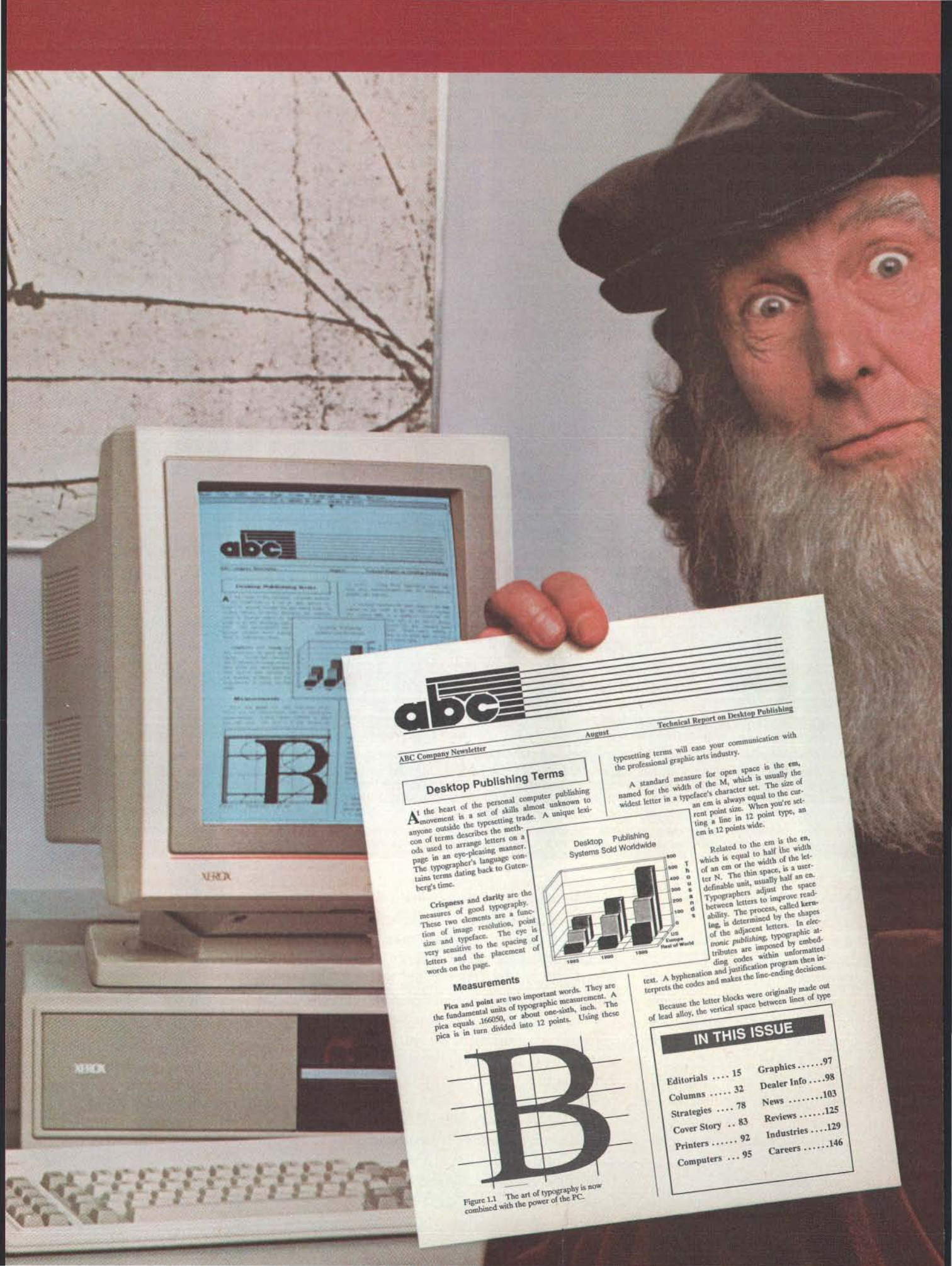
With the DMP-41/42 series, you can choose from an impressive selection of off-the-shelf graphics software packages such as VersaCAD, AutoCAD, and CADKEY. Or, by using Houston Instrument's popular DM/PL™ language, you can create your own custom software and be assured of upward compatibility with Houston Instrument's entire line of plotters.

The DMP-41/42 series. The plotters that offer superb reliability, comprehensive graphics capabilities, and a no frills price. The proven performers for low-cost CAD.

For more information, call 1-800-531-5205 (512-835-0900 if in Texas), or write Houston Instrument,™ 8500 Cameron Road, Austin, Texas 78753. In Europe, contact Houston Instrument, Belgium NV., Rochesterlaan 6, 8240 Gistel, Belgium. Tel.: 32-(0)59-277445. Tlx.: 846-81399.

houston instrument DIVISION / AMETEK

*U.S. suggested retail price. Pricing subject to change. DM/PL and Houston Instrument are trademarks of AMETEK, Inc.



abc

ABC Company Newsletter — August — Technical Report on Desktop Publishing

Desktop Publishing Terms

At the heart of the personal computer publishing movement is a set of skills almost unknown to anyone outside the typesetting trade. A unique lexicon of terms describes the methods used to arrange letters on a page in an eye-pleasing manner. The typographer's language contains terms dating back to Gutenberg's time.

Crispness and clarity are the measures of good typography. These two elements are a function of image resolution, point size and typeface. The eye is very sensitive to the spacing of letters and the placement of words on the page.

Measurements

Pica and point are two important words. They are the fundamental units of typographic measurement. A pica equals .166050, or about one-sixth, inch. The pica is in turn divided into 12 points. Using these typesetting terms will ease your communication with the professional graphic arts industry.

A standard measure for open space is the **em**, named for the width of the M, which is usually the widest letter in a typeface's character set. The size of an em is always equal to the current point size. When you're setting a line in 12 point type, an em is 12 points wide.

Related to the em is the **en**, which is equal to half the width of an em or the width of the letter N. The thin space, is a user-definable unit, usually half an en. Typographers adjust the space between letters to improve readability. The process, called **kerning**, is determined by the shapes of the adjacent letters. In *electronic publishing*, typographic attributes are imposed by embedding codes within unformatted text. A hyphenation and justification program then interprets the codes and makes the line-ending decisions.

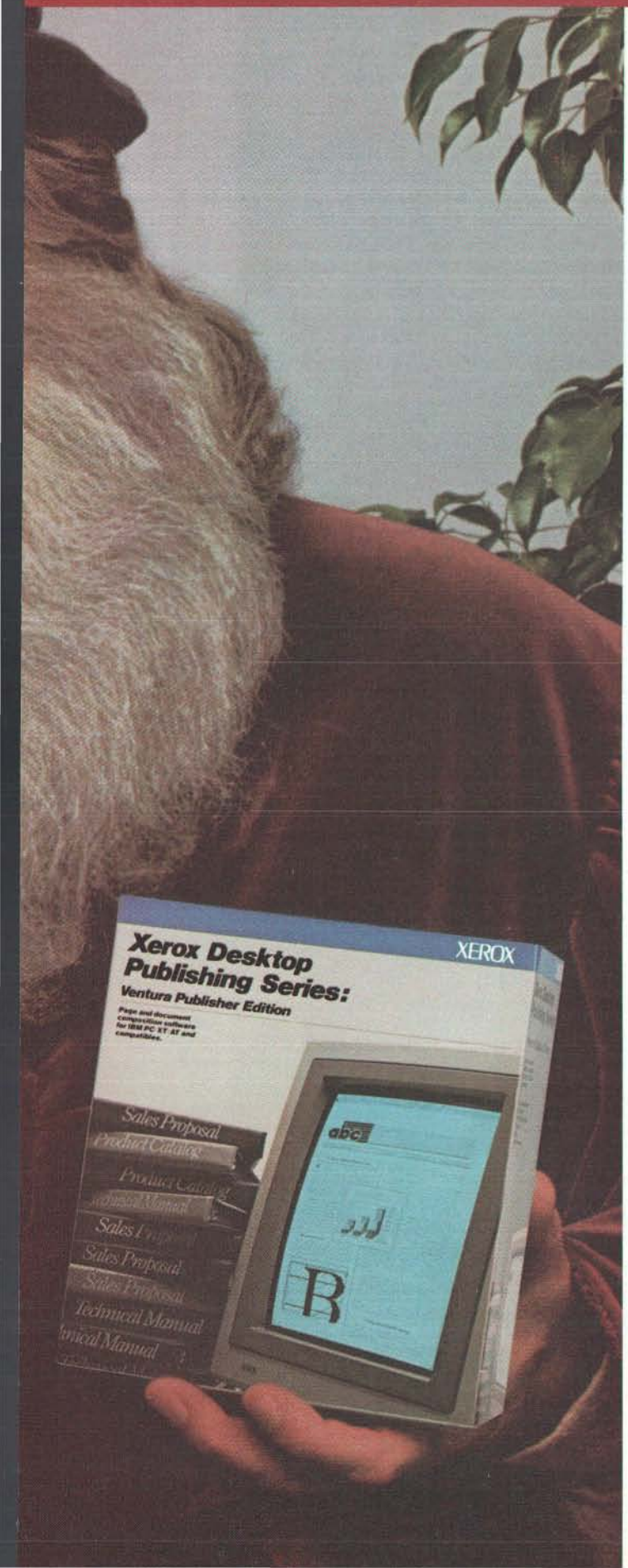
Because the letter blocks were originally made out of lead alloy, the vertical space between lines of type

Figure 1.1 The art of typography is now combined with the power of the PC.

IN THIS ISSUE

Editorials 15	Graphics 97
Columns 32	Dealer Info 98
Strategies 78	News 103
Cover Story .. 83	Reviews 125
Printers 92	Industries 129
Computers ... 95	Careers 146

XEROX



Now, desktop publishing software of such genius, you don't have to be a 'Leonardo' to use it.

Until now, if you were in the IBM PC world and wanted to join the desktop publishing revolution, the software was hard to use, expensive, and often rewarded you with documents that were technically correct, yet visually disappointing.

Enter Xerox genius for creating perfect documents and a new generation of desktop publishing software—Xerox Ventura Publisher. It combines the best of current page-oriented systems with the best of document-oriented systems to make desktop publishing easy as well as productive.

The special genius of Xerox Ventura Publisher is "stylesheets"—20 built-in formats that arrange text and graphics automatically. Choose a stylesheet (or create your own), combine your text and graphics, and Xerox Ventura Publisher goes to work at the amazing rate of 20,000 characters per second, formatting as many as 64 100-page chapters. Most other programs format a page at a time, just like the cut-and-paste process you're escaping.

It's easy. You manipulate text and graphics with a mouse. What you see is what you get when you print. (Buy a new Xerox full-page display, and you won't have to scroll to see your entire page layout.) Make a change on page 1 and before you can say "Leonardo da Vinci," the entire document reformats. Tables of contents, indexing and numbering of pages, sections, tables, captions and figures are automatic.

Unlike most other programs, Xerox Ventura Publisher runs on a standard IBM PC XT/AT or compatible—AT power is not required. Text can be created on, and converted from, most major word processing programs. Graphics can be imported from many graphics and paint programs—even scanned images are easily incorporated. It supports dot matrix, color ink jet and laser printers as well as PostScript printers and typesetters.

Team Xerox

What price genius? The money you'll save by producing your very first 16-page booklet instead of sending it out will probably cover the cost of your very own Xerox Ventura Publisher software.

Xerox brings out the genius in you.

Xerox Corporation, P.O. Box 24, Rochester, NY 14692. 143B

Begin your career as a desktop publishing "Leonardo" by stopping in at any computer store featuring Xerox desktop publishing software, by calling your local Team Xerox sales office or 1-800-TEAM-XRX, ext. 143B.

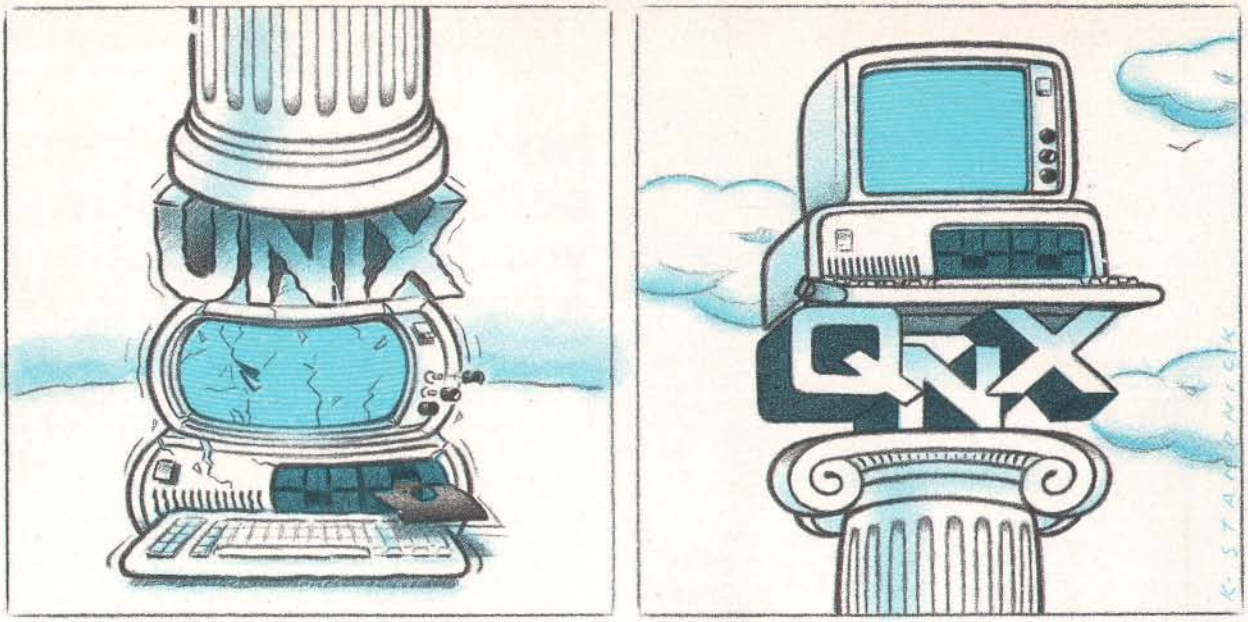
NAME

COMPANY TITLE

ADDRESS CITY

STATE ZIP PHONE 192-3-87

XEROX® is a trademark of XEROX CORPORATION.
VENTURA PUBLISHER® is a trademark of VENTURA SOFTWARE, INC.
IBM® and PC XT/AT are trademarks of INTERNATIONAL BUSINESS MACHINES CORPORATION.
POSTSCRIPT® is a trademark of ADOBE SYSTEMS.



O/S ARCHITECTURE: sink with UNIX or soar with QNX.

If the sheer weight of UNIX brings the PC to its knees, all applications running under it will suffer. Conceived more than a decade and a half ago, UNIX is today the result of modifications, additions and patches by hundreds of programmers. It needs the resources of at least an AT.

Compare this to the QNX O/S, designed by a dedicated team with a common purpose and complete understanding of both the software and the environment in which it must run. Having elegantly solved the problem of inter-task communications, QNX is more than capable of both networking and real time performance – the superior choice for process control and office automation systems.

Quick and efficient on a PC, QNX soars on an AT. QNX occupies 70K (stand-alone version) to 104K (network version) of system memory and allows 40 tasks (programs) and up to 10 terminals per computer.

QNX modular architecture facilitates easy adaptation and extensions by software developers for specific requirements. In addition, PC-DOS runs as a single-tasking guest operating system under QNX. With the DOS Development System, DOS EXE files can be developed in shorter time than under DOS itself.

Communication among all tasks is via "message-passing." Tasks anywhere on a network of up to 255 computers communicate rapidly and transparently with each other.

With the true distributed processing and resource sharing of QNX, all the resources on the network are available to any user. Application programs and data can be distributed over the network without having to go through a central file server.

Network growth is fast and simple. If your disk becomes a bottleneck, add a disk anywhere on the network. If your needs outgrow your present configuration, just add terminals and/or computers as required, without having to re-write programs and without system degradation.

If you would like to know the secret of the QNX architecture, please give us a call. We invite End Users, VAR's, OEM's and Software Developers to discover a whole new world of computing capabilities.

Over 25,000 systems have been installed worldwide since 1982.

Multi-User	10 serial terminals per PC, AT.	**C Compiler**	Standard Kernighan and Ritchie.
Multi-Tasking	40 (64) tasks per PC (AT).	**Flexibility**	Single PC, networked PC's, Single PC with terminals, Networked PC's with terminals. No central servers. Full sharing of disks, devices and CPU's.
Networking	2.5 Megabit token ring. 255 PC's and/or AT's per network. 10,000 tasks per network. Thousands of users per network.		
Real Time	2,800 task switches/sec (AT).	**PC-DOS**	PC-DOS runs as a QNX task.
Message Passing	Fast intertask communication between tasks on any machine.	**Cost**	From US $450. Runtime pricing available.

For further information or a free demonstration diskette, please telephone **(613) 726-1893.**

The only multi-user, multi-tasking, networking, real-time operating system for the IBM PC, AT and compatibles.

By Quantum Software.

Unix is a registered trademark of AT & T Bell Labs. IBM PC, AT, XT and PC DOS are trademarks of IBM Corp.

Quantum Software Systems Ltd., Moodie Drive High Tech Park, 215 Stafford Road, Ottawa, Ontario, Canada K2H 9C1

Inquiry 248

BOOK REVIEWS

COMPUTERS & TYPESETTING
Donald E. Knuth
Addison-Wesley
Reading, MA: 1986

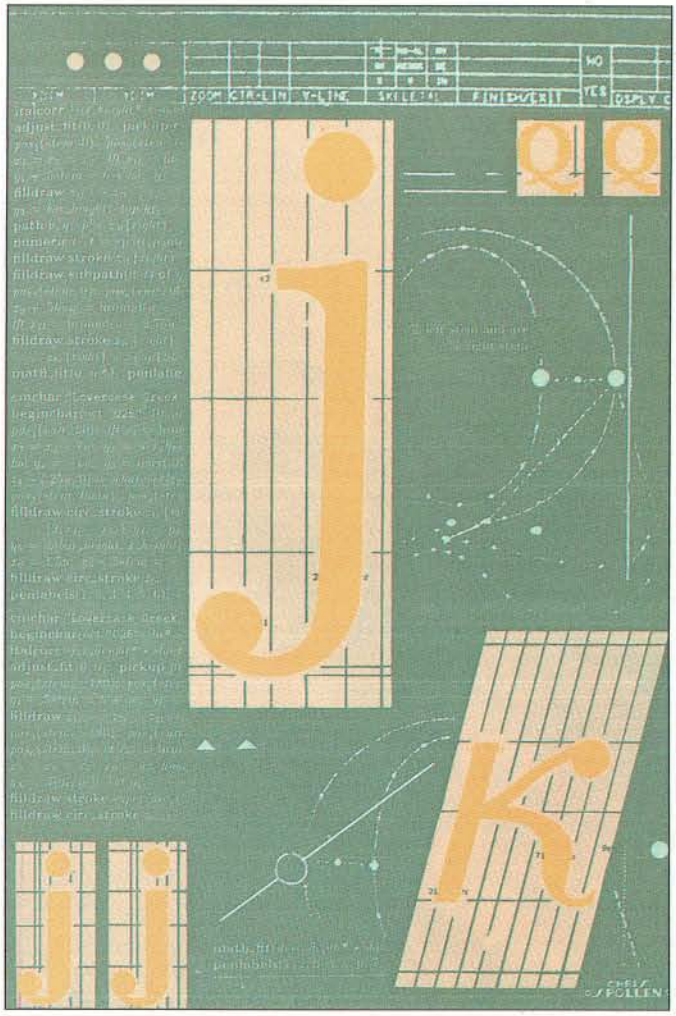
VOLUME A:
THE TEXBOOK
ISBN 0-201-13447-0
483 pages, $29.95

VOLUME B:
TEX: THE PROGRAM
ISBN 0-201-13437-3
594 pages, $34.95

VOLUME C:
THE METAFONTBOOK
ISBN 0-201-13445-4
361 pages, $29.95

VOLUME D:
METAFONT:
THE PROGRAM
ISBN 0-201-13438-1
560 pages, $34.95

VOLUME E:
COMPUTER MODERN
TYPEFACES
ISBN 0-201-13446-2
588 pages, $34.95



Reviewed by Alan Hoenig

The five volumes in Donald E. Knuth's *Computers & Typesetting* series constitute complete documentation of one great achievement in computer science: the development, from scratch, of a professional document formatter (typesetting program) and typefounding (typeface design) program. With these books in hand, you become a participant in the creative process.

Whether or not computer typesetting and typefounding interest you, you will acknowledge the significance of Knuth's system by virtue of its design and implementation and by virtue of this documentation, containing detailed user's guides and superbly documented Pascal code. If you are in any way interested in computer typesetting, you will love these books for what they will tell you about TEX and METAFONT.

A Complete Typesetting System

Don Knuth, a professor of computer science at Stanford University, is known for his ongoing series *The Art of Computer Programming*, of which only the first three massive volumes have appeared (Addison-Wesley: 1973, 1974, 1981). By 1979, Knuth had become seriously dissatisfied with the way these books had been typeset (their math or technical requirements are a typositor's nightmare) and was concerned with the decline in the beauty of typeset mathematics in general (see figure 1, page 68). Then he became aware that digital typesetting machines possessed the necessary sophistication to make serious computer typesetting systems possible. After all, raster devices print out an array of dots, and you simply have to shoot out an array of zeros and ones corresponding to the absence or presence of a dot in the raster display. Knuth realized that he knew as much about zeros and ones as anybody. The eventual results were a typesetting system called TEX (pronounced "tek") and a typefounding system called METAFONT.

Both programs conform to several guiding principles: They must be in the public domain (Knuth retains control only of the names), they must be easily portable to virtually any computer, and the output must be capable of display on any raster device. The final versions of these programs are written in a generic form of Pascal, reportedly because with no clear consensus for first place, everyone seems to agree that it's their second-favorite language.

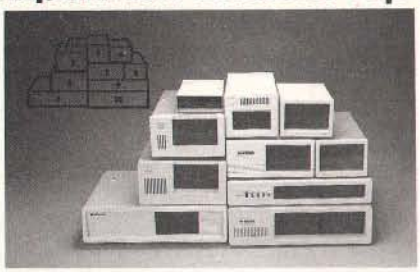
You work TEX by preparing a document file with an ASCII text editor—TEX will complain if it sees any nonprintable characters in the text file. You control the formatting by inserting any of several hundred format commands within your document file. Use TEX to compile this file to produce a device-independent file, which contains all the information that any raster printer needs to generate output. Your document will have the same precise layout on an Okidata dot-matrix printer as it will on an Autologic phototypesetter. Of course, the resolution will differ on the two devices. It's not TEX, but rather a second program called a device driver, that bridges your device-independent output file to your printer. Device drivers have to be specially written and are generally not in the public domain.

Where do the letterforms that TEX works with come from? With great effort, you can force TEX to use the fonts that come with a typical laser printer, but you get vastly superior results if you use the fonts that Knuth designed himself using the META-

continued

ILLUSTRATION BY CHRIS SPOLLEN

Expansion Chassis/Tape Back-up





Specification

Model No.	No. of Slot	Space for ½ Height Drive	Power Supply (Watts)	Dimension D×W×H(cm)	Price
M-1*	0	1	50	30×15×6.5	$139
M-2	3	3	100	42×25×16	$299
M-3	5	3	100	39×30×15	$239
M-4	12	2	100	40×49×14	$299
M-5	0	2	45	39×18×15	$149
M-6	0	1	50	26.5×18×13.5	$169
M-7	5	2	100	38.5×30×13.5	$299
M-8	0	2	45	39.5×18×13.5	$149
M-9	0	2	60	38.5×49×9	$249
M-10	8	4	135	43×49×14	$239

* Extra space for a stand alone controller

EXT and RCV Adapters (Interfacing Computer & Chassis With Slots)...$149

Tape Back-up (With Controller & Cable)....$499

ORDER TOLL FREE: (800) 826-0267
In California Call (408) 434-0877
SOURCE ELECTRONICS CORP.
2380 Qume Drive, Suite E
San Jose, CA 95131
Telex: 279366 Fax: (408) 434-0539

Computerfone™

Interactive Voice Response System



TouchTone In/Voice In/Text In
Voice Out

Excellence in Voice Quality

- *Text-to-Speech*
- *Digitized Speech*
- *Synthesized Speech*
- *Auto Answer/Auto Dial*
- *Host Independent*

Call to hear our demo:
1-904-476-5742

© 1986 Suncoast Systems, Inc. **24 Hrs./7 Days/Wk.**

FONT typefounding system. The source input files to this program consist of a series of draw commands, and a skilled user of METAFONT can create type and other graphic elements of great beauty.

Although these programs are in the public domain and you can alter them as you see fit, Knuth retains control of the names TEX and METAFONT to ensure that all programs identified by these names produce identical output given identical input. Your TEX files are the same whether they were generated by an IBM mainframe or an IBM personal computer.

All five volumes in this series were completely set by TEX using the METAFONT fonts. The five-volume set is a virtuoso graphic arts performance and a testament to the power of TEX and METAFONT. Duane Bibby's rather whimsical lion drawings and the optical characters that make up the ISBN numbers on the back covers appear to be the only exceptions. TEX handles all details of complex layout—setting several type sizes and varieties, automatic hyphenation, justification, kerning, ligatures, multiple columns, superior professional mathematics, and complex paragraph indenting—with ease.

Two New Computer Languages

From a computer enthusiast's point of view, TEX and METAFONT are distinguished not so much by their achievements in the graphic arts as by their structure. Both allow you to place commands in your input files. Both let you string commands together to form new commands. Each program recognizes many primitive commands for assigning values to variables, testing conditions, performing loops, and communicating to the outside world via input and output—in short, all the elements of a high-level computer language. It's entirely appropriate to regard both TEX and METAFONT as new computer languages, albeit with rather special purposes. (METAFONT is particularly unique.) Actually, you could do standard programming in both "languages," although it would waste your computer's resources. So another group of people interested in these books is aspiring compiler writers. Knuth offers prime examples of compilers written in structured, documented Pascal. This audience will read the user's guides as the specifications for these unusual languages.

Volumes A and C are user's guides to TEX and METAFONT, while volumes B and D are the program listings for both pro-

continued

In practice, the left-hand sides of aligned formulas are often blank, and the alignment is often done with respect to other symbols as well as =. For example, the following display is typical; see if you can guess how the author typed it:

$$\begin{aligned} T(n) &\le T(2^{\lceil \lg n \rceil}) \le c(3^{\lceil \lg n \rceil} - 2^{\lceil \lg n \rceil}) \\ &< 3c \cdot 3^{\lg n} \\ &= 3c\, n^{\lg 3}. \end{aligned}$$

The result of \eqalign is a vertically centered box. This makes it easy to get a formula like

$$\left\{ \begin{aligned} \alpha &= f(z) \\ \beta &= f(z^2) \\ \gamma &= f(z^3) \end{aligned} \right\} \qquad \left\{ \begin{aligned} x &= \alpha^2 - \beta \\ y &= 2\gamma \end{aligned} \right\}.$$

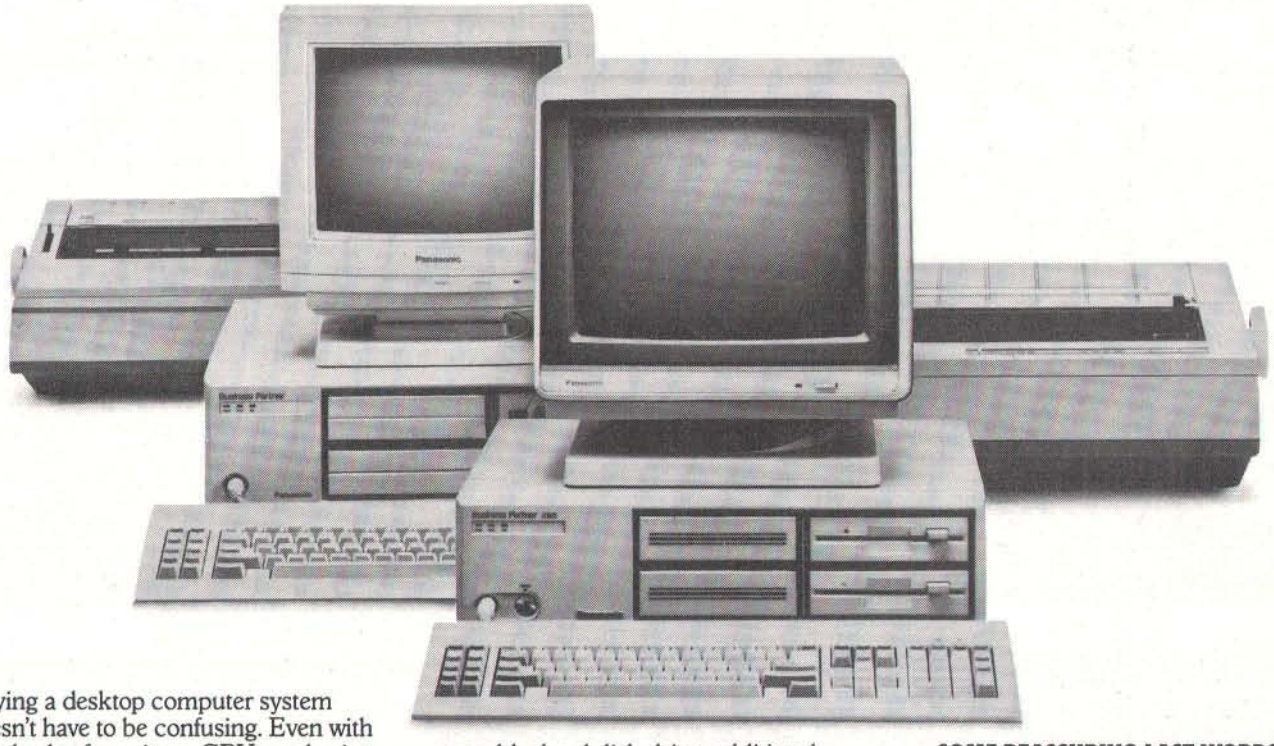
You simply use \eqalign twice in the same line:

```
$$\left\{
\eqalign{\alpha&=f(z)\cr \beta&=f(z^2)\cr \gamma&=f(z^3)\cr}
\right\}\qquad\left\{
\eqalign{x&=\alpha^2-\beta\cr y&=2\gamma\cr}\right\}.$$
```

Figure 1: *An example from* The TEXbook, *showing the capabilities for creating complicated mathematical display equations. An appendix provides answers to all the exercises contained in this volume. Reprinted with permission from Addison-Wesley Publishing Co. Inc.*

Inquiry 294

HOW TO PUT IT ALL TOGETHER WITHOUT GOING TO PIECES.



Buying a desktop computer system doesn't have to be confusing. Even with hundreds of monitors, CPUs and printers on the market. Because one name is all you need to know for system components that fit together with the features you need today, and the power to grow with you tomorrow. Panasonic.



YOUR POWERFUL BUSINESS ALLY.

Build your advanced system around the computers designed to answer your most demanding business requirements. The Panasonic® Business Partner™ and Business Partner 286.™

BUILT-IN FLEXIBILITY.



You can configure the Business Partners to your own individual needs. In addition to their built-in disk drives, you can add a hard disk drive, additional half-height drives—even a magnetic tape drive.

SPEED, PERFORMANCE, POWER, AND FUTURE GROWTH.



Both Business Partners are fast and powerful. The Business Partner 286, with its 80286 processor runs at 6 MHz or 8 MHz and can address up to 15Mb RAM. And as your business grows, so do your Business Partners. They have expansion slots for all the graphics, communications accessories and peripherals you're likely to need.

IMPORTANT DESIGN CONSIDERATIONS.



The deluxe, detachable keyboards have been designed for comfort and ease of use. And we've separated the cursor keys and numeric keys for quick, convenient access.

SOME REASSURING LAST WORDS.

You'll find the Business Partner compatible with the IBM* PC/XT. And the Business Partner 286, with the PC/AT. So you'll be able to run the most popular software. You'll also get compatibility with Panasonic's wide range of quality peripherals. And just as important, both Business Partners are backed with Panasonic's one-year limited warranty.

For more information, mail the coupon and discover how the right Business Partner can make running your business easy.

You'll see: **THE EASIER, THE BETTER.**

Send me information on the Business Partner and Business Partner 286.

Name _____

Company Name _____

Address _____

City _____ State _____ Zip _____

Write: Panasonic Industrial Company, Computer Products Division, Two Panasonic Way, Secaucus, NJ 07094.
Or call: **1-800-PIC-8086.**

BY37

Panasonic Office Automation OA

* IBM is a registered trademark of the International Business Machines Corp.

Inquiry 235 for End-Users.
Inquiry 236 for DEALERS ONLY.

PMI INTRODUCES
FASTCARD®
with 2 MBYTES



10 DAY FREE TRIAL
ONE YEAR WARRANTY

ONLY $295*

The Only Expanded Memory Card Which Can Save A Day Each Week.

A major independent testing laboratory benchmarked a PC-XT equipped with *FASTCARD* and demonstrated a tenfold improvement over a PC-AT on typical Disk I/O operations.

- Portable between IBM PC, XT, AT and compatibles.
- Up to 2MB with Split Memory Mapping to
  - Fill memory to 640K
  - Provide Expanded memory over 640K
- Unique Disk Caching
- Ram Disks (up to 8MB)
- Custom Password Security
- Print Buffering
- Built-in Diagnosis and Automatic Fault Tolerance
- Factory Installed and Tested DRAM's
- Lotus/Intel/Microsoft compatible

*Each *FASTCARD III* comes with 2 MBytes of Memory. *FASTCARD IV*, available with 2 MBytes, includes serial/parallel ports, game port and a clock calendar for $295. Dealer inquiries invited.

LOTUS EMS COMPATIBLE

For additional information, contact PMI
PERIPHERAL MARKETING INC. 602-483-7983
7825 E. EVANS RD., #500, SCOTTSDALE, AZ 85260

SOFTWARE SENTINEL™

MUCH MORE THAN JUST PROTECTION



Stop unauthorized use of software...and keep your customers happy at the same time. The no-interference hardware keys from the industry's leading supplier put money in your pocket and save you from angry customer complaints. Our product line includes devices for either parallel or serial port. The latest addition allows you to **cover multiple programs with one device and/or customize as needed.** Call for new low prices.

SOFTWARE DEVELOPER BENEFITS
- Prohibits unauthorized use of software
- No need for copy protection
- Algorithm technique (never a fixed response)
- Virtually unbreakable
- Higher level language interfaces included
- 100 times faster (1ms) than fixed response devices
- Minimal implementation effort
- Runs under DOS and Xenix, on IBM PC, AT, XT & compatibles

SOFTWARE USER BENEFITS
- Unlimited backup copies
- No floppy required with hard disk
- Pocketsize
- Transparent
- Transportable

RAINBOW TECHNOLOGIES, INC

EVALUATION KIT AVAILABLE

Telex 386078

17971 SKYPARK CIRCLE SUITE E, IRVINE, CA 92714 (714)261-0228

grams. Volume E, the final volume in the series, is a detailed survey of the way Knuth used METAFONT to generate the roman fonts TEX uses.

The TEXbook

Volume A of this series, the user's guide for TEX, has been around for a year or more in a softcover, wire-bound incarnation entitled *The TEXbook*.

First-rate scientists are often first-rate writers. Einstein, Freud (in the original German; he's not well served by his translators), Darwin, and Feynman lead this class, but scores of other scientists have not yet caught the public eye. Knuth emphatically belongs among this group. His book is a model of clear exposition—there are even jokes once in a while (but you have to be sharp and read the text carefully). The book is well organized in a series of short chapters, each centered on a particular TEX topic. But fine science writing undoes itself in a peculiar manner. Science starts slowly as it sets forth the basic concepts and carefully builds the foundation. The unsuspecting reader jumps all too soon to the conclusion that there's no substance to this subject. It's similar to the frog in the biology experiment: The frog luxuriates in a pot of water heated ever so slowly, but by the time the water becomes hot, the animal's muscles are immobile. Gentle reader, heed this lesson while reading *The TEXbook*. Don't be lulled by the gentle temperatures of the early chapters—the water heats up soon.

Knuth imposed two structures on this exposition. On one hand, the first few chapters can be viewed as a very short course on TEX that culminates in a guided hands-on tour of the system (chapter 6). The remainder of the book expands on this introduction. (By the way, you'll better track the learning curve if you have access to TEX and you try things out as you go along. This is no hardship—you'll find TEX is fun. Several implementations of TEX are available for IBM computers and clones, the Apple Macintosh, the Commodore Amiga, and the Atari 1040ST, although these last two have been demonstrated only as of this writing and may not yet be commercially available.)

On the other hand, Knuth has segregated the entire book into two levels, elementary and advanced. Since any particular chapter contains both high and low subject matter, each chapter contains elementary and advanced material. Fortunately, there is no danger of mixing the two levels—the advanced material is set in smaller type, and these paragraphs begin with a "dangerous bend" sign, a logo like a road-sign warning of an approaching hairpin, Z-shaped curve you might encounter on a mountainous pass. Knuth clearly wants his readers to ignore the dangerous bend material on the first pass through the book and to refer to it later on. Scattered throughout the text are problems and exercises, many of which will give most readers a run for their money. The answers to all the exercises are included in the first appendix to the book.

More than a third of the book consists of ancillary material in various appendixes. Most of these topics are advanced and some are for reference, but some of the material is intriguing. I especially like Appendix D, "Dirty Tricks." Here Knuth really makes TEX sit up and beg. Watch TEX perform multilingual double-column typesetting, do elementary Cartesian graphing of points, draw dragon curves, and set hanging punctuation.

The extensive index (another appendix) Knuth prepared is an essential limb enabling you to find things tucked away in obscure corners of this long book. As you get deeper into TEX, you'll find yourself needing to clarify a specific point, so Knuth took great care to index each topic in every reasonable way. The entries use typography to indicate where something is defined, where it's used in a good example, and anywhere else it's mentioned.

continued

Inquiry 256 for End-Users.
Inquiry 257 for DEALERS ONLY.

Order Status, Technical & Other Info. (602) 246-2222

Call for programs not listed

WAREHOUSE DATA PRODUCTS

SPECIAL
WORD PERFECT
$195

TOLL-FREE ORDER LINE 1-800-421-3135

FREE SOFTWARE! FREE SOFTWARE! FREE SOFTWARE!

Purchase over $100 and receive one of these disks absolutely FREE! Purchases over $250 get two free disks, over $400 get three, or get all four disks when your purchase is over $500! **1) MIXED BAG** — A great assortment of utilities and games all packed on one disk. **2) PC-WRITE** — Try this famous feature packed word processor. It's a winner! **3) FONT-SET** — Lets you set popular fonts like bold, underline, etc. on most late model printers from Citizen, Epson, NEC, Okidata, Panasonic, Star, Toshiba, etc. You can even use your printer like a typewriter! **4) ABC-LIST** — Great mailing list program! Sort on any field, do qualified searches, print reports and mailing labels, and more!

DATA BASE MANAGERS

Clipper	$329
Clout 2	Call
Condor III	310
Knowledgeman II	Call
Powerbase 2.2	212
Q&A	Call
Quickcode	138
Quicksilver	295
Quickreport	138
Revelation	469
R: Base System V	Call

WORD-PROCESSING

Easy Extra	88
Microsoft Word	252
Multimate Advantage	Call
Peachtext 5000	145
Volkswriter 3	139
Webster Spellcheck	37
Wordstar	162
Wordstar Propac	233
Wordstar 2000	233
Wordstar 2000+	278

SPREADSHEET

Microsoft Multiplan	108
Spreadsheet Auditor 3.0	82
Supercalc 4	Call
VP Planner	49

ACCOUNTING

BPI AP, AR, PR, GA	299 ea.
Cyma	Call
Dac Easy Accounting	39
Dollars & $ense	94
Managing Your Money 3.0	108

INTEGRATED

Ability	59
Enable	312
Smart Software	Call

COMMUNICATION PROGRAMS

Carbon Copy	115
Crosstalk	89
Remote	89
Smartcom II	83

GRAPHICS

Chartmaster	199
Energraphics 2.0	269
In-A-Vision	275
Microsoft Bus Mouse	106
Microsoft Chart	164
Microsoft Serial Mouse	119
Newsroom	31
PC Mouse W/DR Halo II	106
Printshop	33
Signmaster	Call

PROJECT MANAGER

Harvard Total Project	262
Microsoft Project	219
Super Project Plus	Call
Timeline 2.0	$209

EDUCATIONAL

Flight Simulator	28
Turbo Tutor II	25
Typing Tutor III	Call

LANGUAGES

Lattice C Compiler	242
Microsoft C Compiler	249
Microsoft Fortran	195
Microsoft Macro Assembler	84
Microsoft Pascal Compiler	166
Microsoft Quick Basic	55
Ryan McFarlan Fortran	305
Ryan McFarlan Cobol	479
Turbo Pascal w/8087 + BCD	55

UTILITIES

Copy II PC	19
Copywrite	39
Desqview	55
Double Dos	Call
Fastback	85
Homebase	39
Microsoft Windows	55
Norton Utilities 3.1	48
Prokey 4.0	70
Sidekick (unprotected)	47
Sideways 3.1	36
Superkey	39
Traveling Sidekick	39
XTree	27

ACCESSORIES

Copy II PC Board	75
135 watt power supply	59
Mini Micro Parallel Print Buffer	69
Masterpiece	88
Masterpiece Plus	113

INCREDIBLE VALUES

Nationally advertised boards for IBM PC and most compatibles at give away prices.

Keyboards (similar to 5151)	$79
Monochrome Board w/printer port (similar to Hercules Graphics)	$79
Expansion Board 0 to 576K	$42
Multifunction Board w/game port (similar to AST six pack)	$79
Four Drive Floppy Controller	$39
Color Card w/o printer port	$69
Color card w/printer port	$79

HARD DRIVES

Bernoulli 20 MB w/cont.	Call
Filecard 20 MB	555
Maynard 20 MB Hard Card	Call
Plus Hardcard 20MB	665
Seagate 20 MB Int. w/cont.	$385
Seagate 30 MB Int. w/cont.	479
Seagate 30 AT Int.	Call

KEYBOARDS

Keytronics 5151	162
Keytronics 5153	269

PRINTERS

CANON LASER	1939
CITIZEN	
MSP-10	279
MSP-15	379
MSP-20	315
Premiere 35 Daisywheel	469
EPSON - Call on all models	
FUJITSU	
DX2100 Parallel	Call
DL2400 Ser/Par	Call
LASER IMAGE 2000	Call
NEC	
NEC P5XLP	1095
NEC P7 Parallel	619
NEC 8850	1059
NEC P6 Parallel	439
OKIDATA - Call on all models	
PANASONIC	
1091-I	259
1092	299
1592	425
KXP3151	399
STAR MICRONICS	
NP10	Call
NB15	975
NX10	232
SG15	365
SR15	585
TOSHIBA - Call on all models	

MONITORS

AMDEK 410 Amber	157
AMDEK 600	395
Magnovox Color RGB	Call
Multitech Color RGB	259
Princeton Max 12	159
Samsung TTL Amber	72
Samsung TTL Green	70

EGA MONITORS

AMDEK 722	502
NEC Multisync	Call
Packard Bell EGA	450

EGA BOARDS

Everex Enhancer EGA	235
Paradise Auto Switch EGA Card	359
Quad EGA Plus	349
STB EGA Plus	Call
Vega Deluxe	Call
Vega Video	299

RAM

64K 150NS (set of 9)	10.50
256K 150NS (set of 9)	27
256K 120NS (set of 9)	Call

MODEMS

Everex 300/1200	120
Hayes 1200	Call
Hayes 1200B	Call
U.S. Robotics Courier 2400	$349
U.S. Robotics Passwd. 1200	180

BOARDS

AST Advantage Premium	Call
AST Premium	359
AST Sixpac (384K)	Call
Hercules Color Card	145
Hercules Graphics +	182
Intel Above Boards	Call
J Lazer (Tall Tree)	Call
J Ram III (Tall Tree)	159
J Ram III AT (Tall Tree)	199

COMPUTERS

AZ TURBO PC
IBM Compatible Computer, 4.77 or 7.47 key selectable, keyboard, 640K, dual drive, 150 watt power supply 620
or with 20 MB Seagate Harddrive ..... Call
6 month limited warranty

Corona PC ..... Call

Multitech 900 Accel
IBM AT Compatible, 512K, expandable to 1 MB on the mother board, one 1.2 MB drive, 195 watt power supply, MS/DOS 3.1, clock, 6 or 10 MHZ key selectable, soft white monitor, AT style keyboard, 1 year TRW warranty ..... Call

Multitech Turbo
IBM Compatible Computer, 256K, dual drives, 8 MHZ, ports-parallel-serial-clock, 5151 type keyboard, graphics board (similar to Hercules), mono monitor DOS 3.1, 6 month national warranty ..... Call

Packard Bell VT286
IBM AT Compatible, 640K, expandable to 1 MB on the mother board, one 1.2 MB drive, 210 watt power supply, MS/DOS 3.1, clock, 6 or 8 MHZ, AT style keyboard, 1 year warranty 1600

Sharp Portable ..... Call

TERMS: Shipping on most software is $5.00. AZ orders +6.7% sales tax. Personal check -allow fourteen (14) days to clear. We accept purchase orders from authorized institutions for 3.5% more than cash price. All returns are subject to our approval. There will be a 20% restock fee. Minimum phone order $50. All prices are subject to change.

No Charge for Master Card or Visa

MasterCard VISA

We do not guarantee compatibility

TOLL-FREE ORDER LINE 1-800-421-3135
WAREHOUSE DATA PRODUCTS
2701 West Glendale Ave. • Phoenix, AZ 85051

Phone Hours: Monday, Wednesday & Thursday 7 am-9 pm; Tuesday & Friday 7 am-5 pm; Saturday 9 am-5 pm. MST.

PC/VI™

UNIX's VI Editor Now Available For Your PC!

Are you being as productive as you can be with your computer? An editor should be a tool, not an obstacle to getting the job done. Increase your productivity today by choosing **PC/VI** — a COMPLETE implementation of UNIX* VI version 3.9 (as provided with System V Release 2).

PC/VI is an implementation of the most powerful and most widely used full-screen editor available under the UNIX operating system. The following is only a hint of the power behind **PC/VI:**

- Global search or search and replace using regular expressions
- Full undo capability
- Deletions, changes and cursor positioning on character, word, line, sentence, paragraph, section or global basis
- Editing of files larger than available memory
- Shell escapes to DOS
- Copying and moving text
- Macros and Word abbreviations
- Auto-indent and Showmatch
- MUCH, MUCH MORE!

Don't take it from us. Here's what some of our customers say: "Just what I was looking for!", "It's great!", "Just like the real VI!". "The documentation is so good I have already learned things about VI that I never knew before." — *IEEE Software*, September 1986.

PC/VI is available for IBM-PC's and generic MS-DOS† systems for only $149. Included are CTAGS and SPLIT utilities, TERMCAP function library, and an IBM-PC specific version which enhances performance by as much as TEN FOLD!

PC/TOOLS™

What makes UNIX so powerful? Sleek, Fast, and **POWERFUL** utilities! UNIX gives the user not dozens, but hundreds of tools. These tools were designed and have been continually enhanced over the last fifteen years! Now the most powerful and popular of these are available for your PC! Each is a complete implementation of the UNIX program. Open up our toolbox and find:

- BFS
- CAL
- CUT
- DIFF
- DIFFH
- DIFF3
- GREP
- HEAD
- OD
- PR
- SED
- SEE
- STRINGS
- TAIL
- WC

All of these for only $49.00; naturally, extensive documentation is included!

PC/SPELL™

Why settle for a spelling checker which can only compare words against its limited dictionary database when **PC/SPELL** is now available? **PC/SPELL** is a complete implementation of the UNIX spelling checker, renowned for its understanding of the rules of English! **PC/SPELL** determines if a word is correctly spelled by not only checking its database, but also by testing such transformations as pluralization and the addition and deletion of prefixes and suffixes. For only $49.00, **PC/SPELL** is the first and last spelling checker you will ever need!

Buy **PC/VI** and **PC/TOOLS** *now* and get **PC/SPELL** for only $1.00! Site licenses are available. Dealer inquiries invited. MA residents add 5% sales tax. AMEX, MC and Visa accepted without surcharge. Thirty day money back guarantee if not satisfied! Available in 8", 5¼" and 3½" disk formats. For more information call today!

*UNIX is a trademark of AT&T †MS DOS is a trademark of Microsoft.

CUSTOM SOFTWARE SYSTEMS
P.O. BOX 678 • NATICK, MA 01760
617 • 653 • 2555

CSS

UNIX TOOLS FOR YOUR PC

UNIX TOOLS FOR YOUR PC

But here's the bottom line for most users: Can you learn TEX from *The TEXbook*? You can, but just remember to skip the dangerous bend material on your first pass. Also, personal computer users may be a tad uncomfortable with the book, because it implicitly assumes the existence of resident TEX wizards at your local computer site who can convey the nuts and bolts of TEX usage to you (What switch do I flick now? Where do I stick this floppy disk? What's the best text editor to use?). This assumption makes sense when your site is some VAX or mainframe, but it leaves you hanging when you're trying to work by yourself at your own Macintosh with your own version of TEX. (See editor's note at end of review.) However, the commercial implementations of TEX come with more detailed instructions for getting the program up and running on your computer.

Fortunately, TEX is sufficiently redundant that you can perform good TEX no matter how you start. TEX provides so many ways to do most tasks that you can always rely on a couple of tricks until you master the skills for the more clean and elegant approach. *The TEXbook* will grow with you as you build TEX skills—that's its great advantage. Little by little, even the dangerous bend stuff makes sense.

Addison-Wesley wisely offers *The TEXbook* in two formats. The hardbound edition is perfect for libraries, but the wire-bound edition, in which facing pages lie flat, is just right for those who need a copy right by the computer.

A METAFONT User's Guide

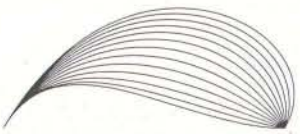
The METAFONTbook, volume C in the typesetting series, is the user's guide to METAFONT, the companion program to TEX (see figure 2). This book parallels *The TEXbook* in many respects. The same structures prevail—introductory first few chapters, advanced remainder, easy material intermingled with dangerous bend material. Again, it's wise to leave the dangerous material until you have some experience under your belt.

Exercises are strewn throughout the book, and once again Duane Bibby has provided the drawings. The index is superb. Knuth employs the same witty, engaging style (but new jokes). *The METAFONTbook* is also available in a less expensive, wire-bound edition for hands-on computing.

The resemblances end there, because METAFONT is so different from TEX. If anything, METAFONT is more interesting, and I find its problems more challenging. It is more the toy than TEX—there are lots of fun things you can do with it—but maybe, as I'm newer to METAFONT, there is just greater novelty.

continued

Here are some of the curves that METAFONT draws between two points, when it is asked to move outward from the left-hand point at an angle of 60°, and to approach the right-hand point at various angles:



This diagram was produced by the METAFONT program

```
for d = 0 step 10 until 120:
    draw (0,0){dir 60} .. {dir -d}(6cm,0); endfor;
```

the 'dir' function specifies a direction measured in degrees counterclockwise from a horizontal rightward line, hence 'dir −*d*' gives a direction that is *d*° below the horizon. The lowest curves in the illustration correspond to small values of *d*, and the highest curves correspond to values near 120°.

Figure 2: *An excerpt from* The METAFONTbook, *demonstrating the versatility and mathematical structure of the METAFONT language. Notice the dangerous bend icon. Reprinted with permission from Addison-Wesley Publishing Co. Inc.*

Inquiry 79

NEW FROM Compuclassics

SOFTWARE

WORD PROCESSORS
LEADING EDGE
Word Processor with Merge & Spell 59.00
LIFETREE
Volkswriter 3 159.00
MICROPRO
Wordstar 179.00
Wordstar Propack 249.00
Wordstar 2000 245.00
MICROSOFT
Word (Version 3) 279.00
MULTIMATE
Multimate 235.00
Multimate Advantage 319.00
SATELLITE SOFTWARE
Word Perfect 219.00
Word Perfect Library 59.00
WORD PROCESSING UTILITIES
BORLAND INTERNATIONAL
Turbo Lightning 62.00
LIVING VIDEOTEXT
Thinktank 99.00
MAX THINK
Max Think 49.00
WRITING CONSULTANTS
Word Finder 60.00
DATA BASE MANAGEMENT
ASHTON TATE
dBase III Plus 419.00
BORLAND INTERNATIONAL
Reflex 85.00
LEADING EDGE
Nutshell 69.00
M.D.B.S.
Kman II 299.00
Kman Bundle 369.00
MICRORIM
RBase 5000 269.00
Clout II 145.00
RBase System V CALL
DATABASE UTILITIES
FOX & GELLER
Quickreport 145.00
NANTUCKET
Clipper 359.00
SOFTWARE TOOLS
Viewgen 95.00
SPREADSHEETS/ INTEGRATED SOFTWARE
ASHTON TATE
Framework II 429.00
COMPUTER ASSOCIATES/I.U.S.
Supercalc 4 295.00
DIGITAL RESEARCH
GEM Draw 159.00
GEM Collection 119.00
GEM Desktop 32.00
LOTUS
Lotus 1-2-3 Version 2 339.00
Symphony 449.00
MICROSOFT
Multiplan 129.00
MIGENT SOFTWARE
Ability 59.00
PAPERBACK SOFTWARE
VP Planner 59.00
SOFTWARE GROUP
Enable 359.00
SOFTWARE PUBLISHING
PFS File, Write, Plan 80.00 each
PFS Report 69.00
SYMANTEC
Q & A 259.00

SPREADSHEET UTILITIES
CAMBRIDGE CO-OPERATIVE
Spreadsheet Analyst 49.00
LOTUS
1-2-3- Report Writer 115.00
TURNER HALL
SQZ 59.00
PRESENTATION GRAPHICS
AMERICAN SMALL BUSINESS
Prodesign II 199.00
BLOC DEVELOPMENT
Form Tool 59.00
DECISION RESOURCES
Chartmaster 209.00
Signmaster 145.00
ENERTRONICS RESEARCH
Energraphics 2.0 329.00
GRAPHICS COMMUNICATIONS
Graphwriter Combo 329.00
Freelance 219.00
MICROGRAFX
PC Draw 199.00
In-A-Vision 249.00
Windows Draw 99.00
MICROSOFT
Chart 189.00
SPRINGBOARD
Newsroom 32.00
T-Maker
ClickArt Personal Publisher 109.00
UNISON WORLD
Printmaster 32.00
Art Gallery I & II 22.00 each
PROJECT MANAGEMENT
BREAKTHROUGH
Timeline 235.00
COMPUTER ASSOCIATES/I.U.S.
Superproject Plus 279.00
HARVARD SOFTWARE
Total Project Manager 279.00
SCITOR
Project Scheduler Network 339.00
ACCOUNTING
COMPUTER ASSOCIATES/I.U.S.
Each Accounting Module 379.00
Payroll 439.00
Easy Plus 89.00
OPEN SYSTEMS
GL/AR/AP/Payroll/Inventory 429.00
Purchase Order/Sales Order/Report Writer 379.00
Resource Manager 239.00
SBT
Accounting Software for dBase III
dLedger/dPayroll/dProject 275.00
dOrder/dInvoice/dPurchase 145.00
PERSONAL MANAGEMENT/ INVESTMENT
MECA
Managing Your Money 105.00
MONOGRAM
Dollars & Sense 99.00
COMMUNICATIONS/ TERMINAL EMULATION
HAYES
Smartcom II 95.00
MERIDIAN TECHNOLOGY
Carbon Copy 109.00
MICROSTUF
Crosstalk XVI 99.00
Remote 99.00
PERSOFT
Smarterm 220 149.00
SOFTKLONE
Mirror (Crosstalk Clone) 39.00
UTILITIES
BORLAND INTERNATIONAL
Superkey 40.00
Sidekick (Unprotected) 48.00
Travelling Sidekick 40.00

CENTRAL POINT
Copy II PC 29.00
Copy II Option Board 90.00
EXECUTIVE SYSTEMS
X-Tree 32.00
FIFTH GENERATION
Fastback 99.00
MICROSOFT
Windows 65.00
PERSONICS
Smart Notes 49.00
PETER NORTON
Norton Utilities 55.00
Norton Commander 37.00
QUAID SOFTWARE
Copywrite 39.00
Zerodisk 55.00
SOFTLOGIC SOLUTIONS
Disk Optimizer 37.00
Double Dos 37.00
Software Carousel 25.00
STERLING SOFTWARE
Intelligent Back-up 79.00
PROGRAMMING LANGUAGES
BORLAND INTERNATIONAL
Turbo Pascal W/8087 & BCD 59.00
Turbo Database Toolbox 40.00
Turbo Tutor 22.00
Turbo Graphix Toolbox 40.00
Turbo Jumbo Pack 169.00
LIFEBOAT ASSOCIATES
Lattice C Compiler 259.00
MICROSOFT
Macro Assembler 95.00
Fortran Compiler 219.00
Quick Basic 65.00
C Compiler 289.00

HARDWARE

MEMORY/MULTIFUNCTION BOARDS
A.S.T. RESEARCH
Six Pack Plus w/64k 170.00
Six Pack Premium w/512k 409.00
Rampage PC with 256k 275.00
Rampage AT with 512k 485.00
PARADISE SYSTEMS
Five Pack with O k 120.00
TALLTREE SYSTEMS
JRAM 3 PC with O k 195.00
JRAM 3 AT with O k 245.00
JLASER 270.00
GRAPHICS CARDS
HERCULES
Monochrome Plus 199.00
Color Card 159.00
PARADISE
Modular Graphics Card 219.00
EGA Auto Switch Card 359.00
SIGMA DESIGNS
Sigma 400 425.00
Sigma EGA 349.00
TECMAR
EGA Master 305.00
ZUCKERBOARD
Color Card (No paralled Port) 59.00
Color Card (Paralled Port) 79.00
Monochrome Graphics (Hercules Compatible) 79.00
I-O Mini w/clock calendar, parallel & serial port 75.00
MODEMS
HAYES
1200 399.00
1200B with Smartcom II 379.00

MIGENT
External Modem–1200 Baud 99.00
PRACTICAL PERIPHERALS
1200 Internal half-card 140.00
MONITORS
AMDEK
310 A 155.00
MAGNAVOX
Monochrome Monitor (Amber/Green) 90.00
Color (320X200) 279.00
NEC
NEC Multisync 599.00
PRINCETON
Max 12E 165.00
HX 12 469.00
SR 12 629.00
PRINTERS
C. ITOH DIGITAL GROUP Call for Prices
CANON
LBP-8A1 Laser Printer 2,285.00
CITIZEN
120D 219.00
Premiere 35 LQ 475.00
EPSON Call for Prices
NEC
Pinwriter P5 1,159.00
Pinwriter P6 529.00
OKIDATA Call for Prices
TOSHIBA
P321 580.00
P351 1205.00
CALL FOR ALL PRINTER ACCESSORIES
PLOTTERS/ PRESENTATION SYSTEMS
POLAROID
Polaroid Palette 1,499.00
SOFTWARE GARDEN
Dan Bricklin's Demo Program 60.00
HARD DISKS/ TAPE BACK-UPS
12 INTERFACE
10 MB External Tape Back-up 579.00
IRWIN MAGNETICS
10 MB Internal Tape Back-up 549.00
20 MB Internal AT Tape Back-up 859.00
MOUNTAIN
20 MB Hard Card 749.00
SEAGATE
20 MB Hard Disk with Controller 469.00
INPUT DEVICES
KEYTRONICS
KB 5151 175.00
MICROSOFT
Mouse with PC Paintbrush 129.00
MOUSE SYSTEMS
Mouse Systems Mouse with DR Halo II 99.00
SURGE PROTECTION/ BACK-UP POWER
COMPUTER ACCESSORIES
P15 Power Director 115.00
EPD
EPD Lemon 6 Outlet 32.00
IBC/TADIRAN
AT Replacement Battery 27.50
KENSINGTON
Masterpiece 89.00
Masterpiece Plus 115.00
RAM CHIPS/ CO-PROCESSORS
Intel, NEC, Toshiba, etc. Call for prices
COMPUTERS
PC/XT Compatible Computers
(FCC & UL Authorized)
Complete PC Systems from under **$850.00**
Complete XT Systems from under **$1,150.00**
Call for price quotation
We can build the system according to your needs

ADVANTAGES

- Orders placed before 3 p.m. (PST) shipped same day.
- We welcome corporate accounts.
- Free technical support.
- Immediate replacement of defective goods.
- Bulk discounts.
- One million dollar inventory.
- Immediate shipment on purchase orders from qualified institutions (schools and universities included).
- No hidden charges.

TERMS:

All prices subject to change without notice. We do not guarantee compatibility. No surcharge for VISA or MasterCard. 2% surcharge American Express. No returns without RA#. Short shipments must be notified within 48 hours. 15% restocking fee on non-defective goods: $3.00 C.O.D. charge. Shipping $4.00 per item, less on bulk orders. ($8.00 Blue Label.) (Higher for some hardware items.)

Order desk & technical support open:
8 a.m. to 6 p.m. Monday–Friday
10 a.m. to 2 p.m. Saturday (PST)
6934 Canby St. Suite #109-110
Reseda, CA 91335
Call for prices for any item not included in this price list.

1 818 705-1895 US **1 800 231-6603 CA** **1 800 328 4473 US**

NEW!

Turbo Pascal Programmers:
15 MINUTES = 200 HOURS!
with new *turboMAGIC™* code generator.

Your productivity increased, or your money back!

Let your imagination run wild! Turn your ideas into state-of-the-art programs. It's easy with *turboMAGIC*, the slickest code generator available for Turbo Pascal. Input forms and help windows up to 66 lines long. Pop-up menus. Pull-down menu systems. And **much** more! *turboMAGIC* will turn 15 minutes of your time into code that would take you hundreds of hours to write. When it comes to forms...we do **more** than Screen Sculptor, Turbo Master and GTP...and we do it **better!**

It's **POWERFUL!** It's **FLEXIBLE!** It's **FAST!** It's **MAGIC!**

Wouldn't you like some magic? Order *turboMAGIC* today. Just $99.00. 30-Day Money Back Guarantee. Not Copy Protected. You can't lose. CALL NOW! 1-800-225-3165 (for Visa & MC orders outside Alabama) or 205-342-7026. For an info-packed brochure, please circle our inquiry number.

Requires: Turbo Pascal 3.0 and a 256K IBM PC compatible.

turbo magic

by
Sophisticated Software Inc.
6586 Old Shell Road
Mobile, AL 36608
(205) 342-7026

TM's: Turbo Pascal — Borland Int'l; Screen Sculptor — The Software Bottling Co.; GTP — Allen, Emerson & Franklin; Turbo Master — Hawaiian Village.

NEW!

2 MEGABYTE MODEL AVAILABLE SOON!



THE 3.5″ CONNECTION!

This internal 720K 3.5″ disk drive is a "drop-in" replacement for 5.25″ drives! It's the ideal solution for exchanging data between your PC/XT/AT and the new generation of laptops. Disk format is compatible with IBM, Toshiba and Zenith portables. The Model 853W drive kit contains everything you need, including interface adapters, premium SONY drive, and complete documentation. Uses your existing disk controller (no additional slots required). Requires DOS 3.2 for maximum performance. Ask about our special prices on SONY DISKS!

SONY DISKS
$$ SAVE $$

Tigertronics™
INCORPORATED

$159.95
+ FRT. & TAX

MasterCard

2734-C Johnson Drive
P.O. Box 3717
Ventura, CA 93006

VISA

IMMEDIATE DELIVERY!
Call 805-658-7466 or 805-658-7467

Why is METAFONT so nifty? As you might expect in a program that creates letterforms, there are a variety of commands that shape, position, and draw using an imaginary pen nib. The fun begins, though, because you can instruct METAFONT to do its work on-line and actually watch the creation process taking place on your screen. METAFONT uses an elegant algorithm for deciding which graceful curves will connect several points.

But there's more. Because people find it easier to specify certain key points as intersections of given lines (such as the central peak in an uppercase W) rather than by coordinates, METAFONT solves systems of linear equations for you, and does it on-line. Still more, METAFONT can even attack nonlinear equations. For many people, this alone is worth the price of the package. (PC versions of METAFONT will be available from Addison-Wesley and from Personal TEX, mentioned below.)

Because of its graphic nature, METAFONT lends itself better to recreational purposes than does TEX. At one point, you'll come upon a recipe for playing John Conway's Game of Life on-line with METAFONT. Martin Gardner would highlight this game from time to time in his late, lamented "Mathematical Games" column in *Scientific American*. Life is a set of rules whereby one pixel configuration evolves to some new state in the next generation. If you're clever enough to choose your original configuration carefully, you'll generate the stills for some surrealistic cartoon.

A Coffee-Table Volume

If you assiduously read *The METAFONTbook*, you'll be master of all the tools you need to create your own alphabet, at least in theory. But Knuth only gives examples of very simple letters in volume C. How difficult is it to expand on these skills and create an alphabet of beauty and serviceability, replete with thick and thin strokes that blend gracefully into the flangelike serifs of good roman type? How hard is it to create an alphabet suitable for the finest texts?

It turns out to be very difficult, as you soon appreciate by glancing through the pages of the final volume of this series, *Computer Modern Typefaces*. This volume presents the METAFONT source programs for all characters in the basic fonts, including uppercase and lowercase letters, digits, punctuation, math symbols, and ligatures. Each letter is specified in terms of about 60 parameters that are adjusted to various values or turned on or off. The idea is that adjusting these things carefully, we can generate a wide variety of different fonts. This was Knuth's original goal, and it explains the origin of the prefix "META."

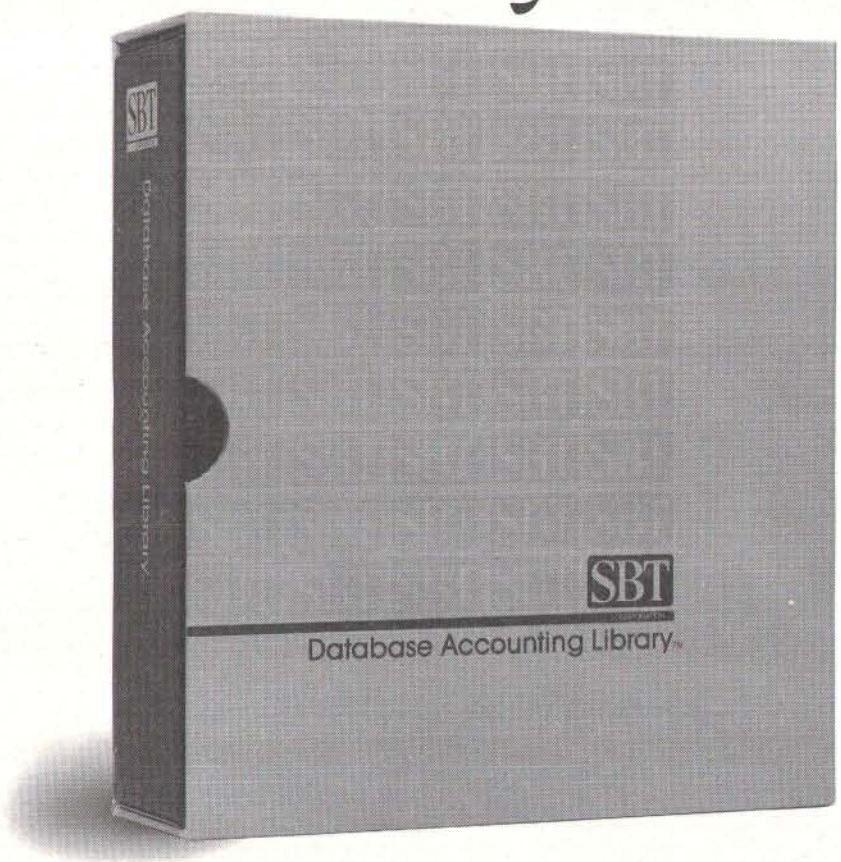
You can adjust these parameters with one of two goals in mind. First, by carefully scaling certain parameters, you create different sizes of a particular font. It's a common misconception that a 24-point version of some font is geometrically similar to its 12-point version. Wrong! Each size has to be subtly adjusted. (Printers traditionally measure the size of type in points. There are 72.27 points in an inch. To speak of type as being 12 point—about 1/6 of an inch—means that the height of a parenthesis in that font is 12 points.)

Second, by scaling other parameters you can create different font styles. For example, by slanting a roman font and softening some of the curves, you approximate the corresponding italic. Because these fonts share the same underlying structure, there will be a visual unity that might be missing in type designed entirely by hand.

Although physically a match for its siblings in the series, *Computer Modern Typefaces* plays the role of star. The bulk of the book contains the METAFONT programs for each character, together with large proof mode examples of each, the proofs being rendered in substantially enlarged 10-point roman, 10-point

continued

Free source code in every box.



Actually, we give you two things free.

Our source code. And your freedom.

Just buy part or all of our excellent integrated business accounting system, the SBT Database Accounting Library.

We'll give you our source code absolutely free.

Which, in turn, gives you the freedom to customize our software to fit your business needs.

Say, for instance, you want to change the way a management report is formatted. Our free source code enables you to change it.

What's more, the change will be quick and simple because our software is written in easy-to-use dBASE.

In fact, the entire SBT Database Accounting Library runs with dBASE III PLUS, so you get the power and flexibility of the best-selling database manager on the market. Plus the freedom to use any computer that runs it.

The SBT Database Accounting Library. Great software and freedom. All in the same box.

Call today for our demo disk and brochure. (415) 331-9900.

Call today for the name of the SBT consultant in your area.

THE SBT DATABASE ACCOUNTING LIBRARY.

dProfessional	Time & Billing	$395
dOrders	Sales Order Processing	$295
dInvoice	Billing/Inventory Control	$295
dStatements	Accounts Receivable	$100
dPurchase	Purchase Order	$295
dPayables	Accounts Payable	$395
dPayroll	Payroll/Labor	$395
dLedger	General Ledger/Finance	$395
dAssets	Asset/Depreciation	$295
dProject	Project/Job Accounting	$395
dProperty	Tenant/Unit Management	$395
dMenu/Backup	Menu/Backup	$ 65

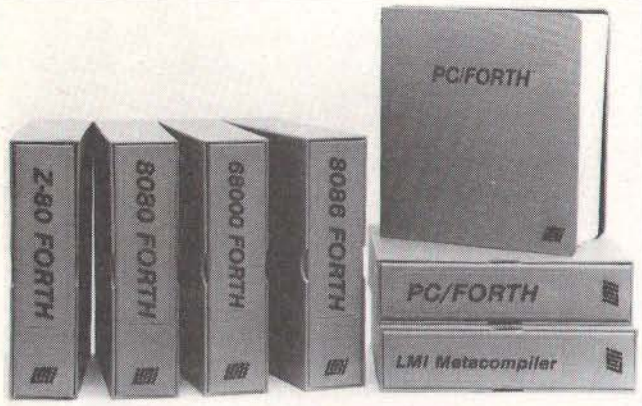
MultiNet versions $200 additional per module

SBT CORPORATION

Three Harbor Drive
Sausalito, CA 94965
(415) 331-9900

Compiled and Multi-User versions also available. dBASE III PLUS is a registered trademark of Ashton-Tate, Inc. © 1986, SBT Corporation.

TOTAL CONTROL
with *LMI FORTH*™



For Programming Professionals:
an expanding family of compatible, high-performance, Forth-83 Standard compilers for microcomputers

For Development:
Interactive Forth-83 Interpreter/Compilers

- 16-bit and 32-bit implementations
- Full screen editor and assembler
- Uses standard operating system files
- 400 page manual written in plain English
- Options include software floating point, arithmetic coprocessor support, symbolic debugger, native code compilers, and graphics support

For Applications: Forth-83 Metacompiler

- Unique table-driven multi-pass Forth compiler
- Compiles compact ROMable or disk-based applications
- Excellent error handling
- Produces headerless code, compiles from intermediate states, and performs conditional compilation
- Cross-compiles to 8080, Z-80, 8086, 68000, 6502, 8051, 8096, 1802, and 6303
- No license fee or royalty for compiled applications

For Speed: CForth Application Compiler

- Translates "high-level" Forth into in-line, optimized machine code
- Can generate ROMable code

Support Services for registered users:

- Technical Assistance Hotline
- Periodic newsletters and low-cost updates
- Bulletin Board System

Call or write for detailed product information and prices. Consulting and Educational Services available by special arrangement.

Laboratory Microsystems Incorporated
Post Office Box 10430, Marina del Rey, CA 90295
Phone credit card orders to: ***(213) 306-7412***

Overseas Distributors.
Germany: Forth-Systeme Angelika Flesch, Titisee-Neustadt, 7651-1665
UK: System Science Ltd., London, 01-248 0962
France: Micro-Sigma S.A.R.L., Paris, (1) 42.65.95.16
Japan: Southern Pacific Ltd., Yokohama, 045-314-9514
Australia: Wave-onic Associates, Wilson, W.A., (09) 451-2946

Knuth has long advocated the concept of programs as literature, and now he can put his money where his mouth is.

typewriter style, and 10-point sans serif bold extended. These drawings are shown on a grid, with their key points labeled. Although details of other important METAFONT files are in the book, it's these drawings that occupy center stage. Leaf through a copy. At this large scale, the curves of many of these handsome characters take on a hypnotic quality. Knuth calls this the "coffee-table book" of the set. A smaller section at the end of the book contains specimens of all styles and sizes of type.

As in the other volumes, amusing nuggets are scattered throughout. Knuth presents, for example, a font whose numerical parameters occur somewhere in the Fibonacci sequence (0, 1, 1, 2, 3, 5, 8, 13, etc.) in hopes that "these will yield an especially pleasing alphabet." (Perhaps there is beauty in mathematics, as the mathematicians have been saying all along.) Also, be sure to check out Computer Modern Funny Roman and its italic.

Computer Programs as Literature

The two remaining volumes (B and D) contain the listings for the TEX and METAFONT programs. Well, not quite; further explanation is needed.

Knuth has already developed the WEB system of structured documentation to use in tandem with the writing of large programs such as TEX. (WEB is also in the public domain.) You prepare a file containing the source code, documentation, and certain formatting instructions. The WEB system consists of a pair of programs, TANGLE and WEAVE. Letting TANGLE loose on your source generates Pascal object code. Running your source through WEAVE generates a file that you next run through TEX and print. Your final output will be a handsome mélange consisting of the program code and documentation, plus a few other nice features. (For a fuller explanation, see the "Programming Pearls" columns in the May and June 1986 issues of the *Proceedings of the ACM*.) What you get in these books is the WEAVE printout. (For nominal fees, Stanford University will provide you with computer tapes containing the WEB source for both TEX and METAFONT and the WEB programs. WEB user's guides are also available from Stanford.)

There's certainly a utilitarian purpose in making such programs available—you might want to modify them for your own computer. Is there another point in making large-scale program listings available to the general public? I think that there is. Architects avidly study the works of their colleagues. Scientists turn to scholarly publications to examine the work of their fellows. Novelists read other people's novels. But when was the last time you studied someone else's program? If you're a serious programmer, here's your chance to review the work of a world-class programmer.

Knuth himself has long advocated the concept of programs as literature, and he now has a chance to put his money where his mouth is. You'll like the presentation. The program is heavily segmented, each such module being consecutively numbered. WEB performs cross-referencing and tells you the numbers of the other sections that use this module. In addition to the usual comprehensive index at the end of each volume, at the bottom of each right-hand page there is a mini-index to the rest of the book of all terms, variables, and modules that appear on this and the facing page. This must have been difficult to implement, but it's one of those ideas like the invention of the wheel or dif-

continued

Inquiry 160

Inquiry 282→

Softline PRICE BUSTERS



Lotus 1-2-3	Paradox	dBase III Plus	Rapid File	Multimate Advantage	Word Perfect 4.2
$319	$449	$399	$Call	$299	$219

Software

Word Processing

FANCY FONT	$139
FINAL WORD II	$199
MICROSOFT WORD 3.0	$279
MULTIMATE	$249
MULTIMATE ADVANTAGE	$299
OFFICE WRITER/ SPELLER 5.0	$259
PFS: PROF WRITE	$149
SAMNA WORD IV	$349
THINK TANK	$109
TURBO LIGHTNING	$ 65
VOLKSWRITER 3	$159
VOLKSWRITER SCIENTIFIC	$259
WORD PERFECT 4.2	$219
WORDSTAR 2000	$249
WORDSTAR 2000 +	$289
WORDSTAR PRO	$259
XYWRITE III	$199

Database Systems

CLIPPER	$ 349
CONDOR III	$ 339
DBASE III PLUS	$ 399
FOXBASE +	$ 339
KMAN 2	$ 339
PARADOX	$ 449
PFS: PROF FILE	$ 149
Q&A	$ 229
QUICKCODE III	$ 159
QUICKREPORT	$ 159
QUICKSILVER	$ 359
R BASE SYSTEM V	$ 359
RAPIDFILE	$Call
REFLEX	$ 89
REVELATION	$ 499

Spreadsheets/ Integrated Packages

ENABLE	$ 349
FRAMEWORK II	$ 399
JAVELIN	$Call
LOTUS 1-2-3	$ 319
MULTIPLAN	$ 125
OPEN ACCESS II	$ 229
SMART SYSTEM	$ 439
SPREADSHEET AUDITOR	$ 99
SUPERCALC 4	$ 289
SYMPHONY	$ 449
TWIN	$ 79
VP PLANNER	$ 59

Graphics

CHARTMASTER	$209
CLICKART	$119
DIAGRAPH	$309
DIAGRAM MASTER	$189
ENERGRAPHICS 2.0	$299
FREELANCE PLUS	$359
GEM DRAW	$149
GRAPHWRITER COMBO	$309
HARVARD PRESENTATION GRAPHICS	$239
IN-A-VISION	$259
MAPMASTER	$219
MS CHART	$189
PC DRAW	$209
PC PAINTBRUSH PLUS	$109
PICTURE PERFECT	$245
PRODESIGN II	$189
SIGNMASTER	$139
WINDOWS/DRAW	$119

Project Management

HARVARD TOTAL PROJECT MANAGER	$279
MICROSOFT PROJECT	$249
PROJECT SCHEDULER NETWORK	$339
SUPERPROJECT PLUS	$269
TIMELINE 2.0	$259

Communications/ Productivity Tools

CARBON COPY	$ 129
CROSSTALK XVI	$ 99
CROSSTALK MKIV	$ 139
PROKEY	$ 85
RELAY GOLD	$ 129
REMOTE	$ 109
SMARTERM	$Call
SMARTCOM II	$ 99
SUPERKEY	$ 55

Statistics

SPSS/PC +	$699
STATGRAPHICS	$469
STATPAC GOLD-WALONICK	$399
SYSTAT	$469

Accounting

BPI	$309
GREAT PLAINS	$479
IUS EASYBUSINESS	$349
ONE WRITE PLUS	$159
OPEN SYSTEMS	$409
REAL WORLD	$399

Network Applications

CROSSTALK XVI	$419
DBASE III LAN PAK	$599
KMAN 2	$899
MULTIMATE	$639
MULTIMATE ADVANTAGE	$749
REVELATION	$999
WORD PERFECT SERVER	$309
WORD PERFECT STATION	$ 75

Languages/Utilities

COPYWRITE	$ 45
FASTBACK	$ 89
LATTICE C	$ 259
MICROSOFT C COMPILER	$ 289
MS BASIC COMPILER	$ 249
MS FORTRAN	$ 229
NORTON UTILITIES	$ 59
QUICK BASIC	$ 69
TURBO PASCAL	$ 69
TURBO PROLOG	$ 69
XENIX	$Call
ZERO DISK	$ 70

Desktop Environments

GEM DESKTOP	$39
MS WINDOWS	$65
SIDEKICK	$59

Hardware*

Mass Storage/Backup

IOMEGA 10 + 10 W/INTFC	$1999
IOMEGA 20 + 20 W/INTFC	$2599
IRWIN 120D 20MB TBU	$ 469
IRWIN 145AT 40MB TBU	$ 579
MOUNTAIN DRIVECARD 20MB	$ 719
PLUS HARDCARD 10MB	$ 569
PLUS HARDCARD 20MB	$ 699
PRIAM 42MB AT	$ 949
SEAGATE 20B W/INT	$ 399
SYSGEN SMART IMAGE 20MB (INT)	$ 625
TALLGRASS	$ Call
TECMAR QIC-60AT TBU (INT)	$1199

Multifunction Boards

AST ADVANTAGE (128K)	$ 349
AST 6 PAK PLUS (64K)	$ 169
AST I/O MINI II	$ 169
AST PREMIUM PAK	$ 359
AST RAMPAGE PC	$ 279
AST RAMPAGE AT	$ 439
INTEL ABOVEBOARD	$Call
JRAM AT-3 (0K)	$ 239
JRAM 3 (0K)	$ 179
PC TURBO 286 (1MB)	$ 799
PC TINY TURBO 286	$ 459
QUADBOARD (64K)	$ 139

Display Boards

HERCULES GRAPHICS CARD PLUS	$189
HERCULES COLOR CARD	$159
ORCHID TURBO EGA	$619
PARADISE AUTO SWITCH EGA	$369
PARADISE MODULAR GRAPHICS	$259
QUADRAM EGA +	$339
SIGMA COLOR 400	$449
STB EGA PLUS	$299
TECMAR EGA MASTER	$299
TSENG ULTRA PAK	$429
TSENG EVA 480	$469

Emulation Boards

AST 5211-11 +	$ 649
AST 5251-12	$ 499
AST BSC	$ 489
AST SNA	$ 599
FORTE	$Call
IRMA	$ 725
SMART ALEC 5251	$ 699

Modems

AST REACH 1200	$359
HAYES 1200	$389
HAYES 1200B	$349
HAYES 2400	$579
HAYES 2400B	$549
TRANSNET 1000	$279
US ROBOTICS 1200B	$109
US ROBOTICS 2400B	$189
VENTEL 1200 HALF CARD	$369
VENTEL 1200 PLUS	$299
WATSON	$339

Monitors

AMDEK 310A	$159
AMDEK 600/722	$429/539
NEC MULTISYNC	$599
PRINCETON HX-12	$449
PRINCETON MAX-12E	$179
PRINCETON SR-12	$599
PRINCETON HX-12E	$539
PRINCETON HX-9	$529
TAXAN 122 AMBER	$159
TAXAN 630/640	$469/539

Networks

AST PC NET	$Call
NOVELL	$Call
ORCHID PC NET	$Call

Printers/Plotters

EPSON EX-1000	$ 699
ESPON FX-85	$ 399
EPSON FX-286	$ 579
EPSON LQ-800	$ 589
EPSON LQ-1000	$ 769
HP 7475A	$1499
NEC 3550	$ 799
OKIDATA 192 +	$ 389
OKIDATA 193 +	$ 569
OKIDATA 292	$ 539
OKIDATA 293	$ 689
TOSHIBA P321	$ 499
TOSHIBA P341 E	$ 769
TOSHIBA P351 MODEL 2	$1199

Input Devices

KEYTRONICS 5151	$169
KEYTRONICS 5153	$299
MICROSOFT MOUSE	$129
PC MOUSE W PAINT +	$129

Accessories

CURTIS RUBY	$ 65
DATASHIELD S-100	$ 79
GILTRONIX SWITCHES	$Call
LOGICAL CONNECTION	$ 259
MASTERPIECE PLUS	$ 135
MICROFAZER II	$ 269
256K RAM SET	$ 39
8087 MATH CHIP	$ 119
80287 MATH CHIP	$ 189

*CALL FOR SHIPPING COSTS

NEC Multisync	Plus HardCard 20	Quadram EGA+	US Robotics 1200 B	US Robotics 2400B	IRMA Board
$599	$699	$339	$109	$189	$725

FREE SHIPPING
on all orders over $1000.00, credit card orders and prepaid orders.

Our Policy:
• Visa or Mastercard — add 3% • COD — Cash, M.O. or bank check only — add $5.00 per order • Prepaid personal or company check — allow two weeks to clear • No sales tax on orders shipped out of NY State • Shipping via UPS surface — add $3.00 per item; UPS Blue — add $8.00 per item • All returns require prior authorization • Prices subject to change, call for latest prices

MasterCard VISA **1-800 221-1260**

In New York State call (718) 438-6057

Softline

P.O. Box 729, Brooklyn, NY 11230
TELEX: 421047 ATLN UI
FAX: 718-972-8346

SIX MODES OF MULTIPLEXING IN ONE SMART UNIT



THE 525H

Multiplex data from multiple devices to one port on a computer with an H-series multiplexer from BayTech. Its versatility makes it the ideal choice for data collection and control applications. You tailor this multi-function device to your own environment by selecting one of six modes of operation: time-division multiplexing, port expansion/sharing, or four types of buffered message multiplexing.

The Model-H is a stand-alone RS-232C multiplexer that connects between one host computer and up to 17 peripheral devices. It provides full duplex transmission of asynchronous data at speeds up to 19,200 bps. Selecting the mode of multiplexing (and also the baud rates, control character, data block size, message terminating character, etc.) is as easy as answering questions from a menu. All parameters are saved permanently in non-volatile memory.

In a size to fit large and small applications:
The 525H with four peripheral ports, $395.
The 528H with eight peripheral ports, $649.
The 5212H with eleven peripheral ports, $1,095.
The 5218H with seventeen peripheral ports, $1,495.

CALL FOR YOUR FREE BROCHURE
800 523-2702

Bay Technical Associates, Inc.
Highway 603, PO Box 387
Bay St. Louis, MS 39520
Telephone 601 467-8231
Telex 910-333-1618 BAYTECH

BayTech
DATA COMMUNICATIONS PRODUCTS

Inquiry 37

ferentiation that seem self-evident after you see them in action.

Good things flow from documentation as structured as this. Of prime importance is that you can use the listing as the ultimate arbiter for any problems with TEX or METAFONT. Second, it's easy to comprehend these programs. Each listing of TEX and METAFONT contains roughly half a megabyte of Pascal source code, but because WEB makes them so readable, Knuth estimates that more people are familiar with their innards than with any other comparably sized program.

Finally, it's easy to debug such programs. Knuth is confident that there is at most one more bug in TEX, the last known TEX one having been squashed in November 1985. TEX has accumulated many tens of thousands of user-hours since then with nary a bug in sight. (By the way, if you're the first to snare the bug, Knuth will pay you $20.48. Next year, the rate rises to $40.96, and so on. There's also a bounty on mistakes in any of these typesetting volumes.) This latest version of METAFONT is bug-free, at least so far.

Other Possible References

Knuth's aim in preparing this series is to provide complete documentation to his vision of computer typesetting. These five books are not the whole story, though. You may want to consult several reports of the Computer Science Department at Stanford for fuller explanations of certain aspects. There are alternatives for learning "first-grade" TEX. Two texts written by Mike Spivak are *The PC-TEX Manual*, a chatty and well-written introduction ($19.95 from Personal TEX Inc., 20 Sunnyside Ave., Suite H, Mill Valley, CA 94941), and *The Joy of TEX*, an introduction to AMS-TEX, an enhanced variant of TEX especially prepared for mathematicians ($35 from the American Mathematical Society, P.O. Box 1571, Annex Station, Providence, RI 02901-1571, (800) 556-7774). The TEX Users Group (TUG), an offshoot of the American Mathematical Society, publishes *First Grade TEX: A Beginner's TEX Manual* by Arthur L. Samuel. This is available from TUG, as is their newsletter, "The TUGboat," which publishes articles of TEXnical merit (TUG, P.O. Box 9505, Providence, RI 02940). Of interest will also be *TEX and METAFONT: New Directions in Typesetting* (Digital Press/American Mathematical Society, 1979), in which you'll see the clearer motivations into this system, how these programs used to work, and fuller explanations of some of the mathematical underpinnings (particularly in the drawing routines of METAFONT). ■

Editor's note: *Addison-Wesley's disk set for TEX to be implemented on microcomputers is called MicroTEX. It is designed for the IBM PC family and compatibles; a hard disk is recommended because the system requires MS-DOS and 512K bytes of RAM. Version 1.5A1 costs $295. A disk set for TEX implementation on Macintosh computers, called TEXtures, costs $495. Both are available from the Order Department, Addison-Wesley, Reading, MA 01867, (617) 944-3700.*

TEX for the PC family is also available from Personal TEX Inc., 12 Madrona St., Mill Valley, CA 94941, (415) 388-8853. A version of TEX for the Macintosh, called MacTEX, is available from FTL Systems Inc., 234 Eglinton Ave. East, Suite 205, Toronto, Ontario, Canada, (416) 487-2142. A version of TEX for the Amiga is available from N² Computer Consultants, P.O. Box 2736, College Station, TX 77841.

Dr. Alan Hoenig (17 Bay Ave., Huntington, NY 11743) is a professor of mathematics at a branch of the City University of New York and a TEX consultant. He has written extensively on microcomputers, with books published by Little, Brown and William C. Brown Co. His latest book, a college text, is due to be published by Random House shortly.

THE REMOVABLE MOUNTAIN. OUR NEW MICRO BERNOULLI.



Isn't this the data storage you've always wanted for your IBM,® AT&T,™ Zenith,® COMPAQ® and most compatibles? The fast access speed and capacity of a hard disk. The removability of a floppy. And the assurance of *no* head crashes. All packaged in a cartridge drive that can fit a 5¼" half-high drive slot or sit next to your monitor. (Either way, zero footprint means you don't lose an inch of desk space.)

PEAK PERFORMANCE IN A PORTABLE PACKAGE.

The famous "Bernoulli Box®" used in more than 200,000 installations is now available in a small size. You get unlimited storage capacity with 20 megabyte cartridges, fast 40 millisecond average seek time, and better reliability than a standard hard disk.

YOU CAN MOVE MOUNTAINS.

These cartridges are really handy. Use them to transport large files, secure sensitive data, or backup your hard disk. And don't worry about dropping one. The Bernoulli cartridge can withstand a drop without losing one bit of data.

THERE'S A MOUNTAIN BEHIND YOU.

Mountain backs micro Bernoulli drives with a one year limited warranty featuring "ready replacement" anytime within the first three months. Ask for the Mountain Series 9000 micro Bernoulli at leading computer stores everywhere.



Mountain Computer, Inc. 360 El Pueblo Road, Scotts Valley, CA 95066, (408) 438-6650, TWX 910-598-4504, FAX 408-438-7623

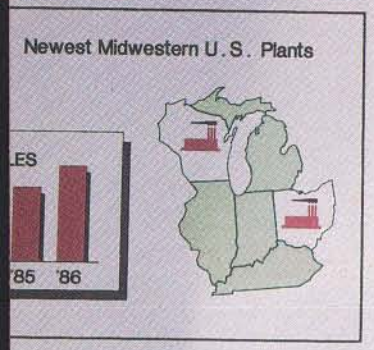
Mountain products are distributed and sold worldwide. Call or write for the name of the representative nearest you.

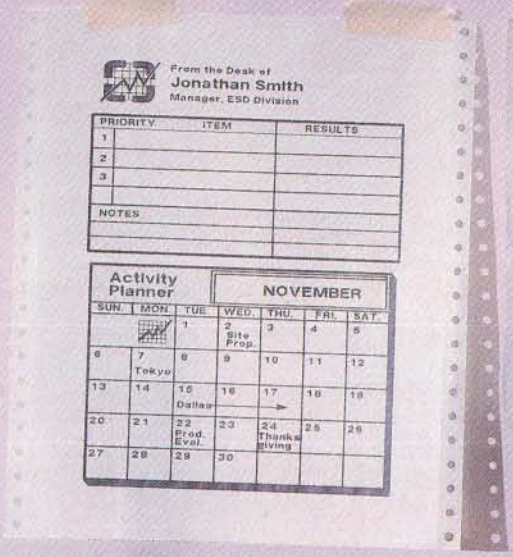
*registered trademarks and "trademarks of Mountain Computer, Inc., American Telephone and Telegraph Co., International Business Machines Corp., COMPAQ Computer Corp., Zenith Electronics Corp. and IOMEGA Corporation. ©1986 Mountain Computer, Inc.

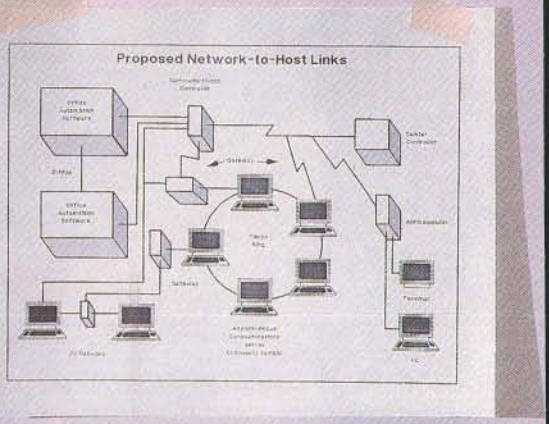
Mountain.

THE PEAK OF PERFORMANCE

1-800-458-0300 (in Calif., 1-800-821-6066)







Lotus® always wanted to get into pictures. It was just a matter of getting the product exactly right.

That's why Freelance® Plus is big news. It's a powerful graphics package for business that adds real punch, real impact to all your work. Whether it's memos, reports, forms, bulletins, schedules or full-blown presentations.

Freelance Plus works with many popular PC software packages. Like 1-2-3,® Symphony,® Graphwriter,® Freelance Maps and dBase.® Plus you can use it with programs like Lotus Manuscript™ to merge text and graphics into a single document.

Freelance Plus gives you all the graphics tools you need. Maps. Diagrams. Symbols. Standard business charts. Logos. Editing. For paper. For slides. For overheads. *All in one program.*

And the best part is, the more you use it, the more you'll discover you can do with it.

Freelance Plus. Designed to become the standard for business graphics. Because it allows you to picture what you're trying to say.

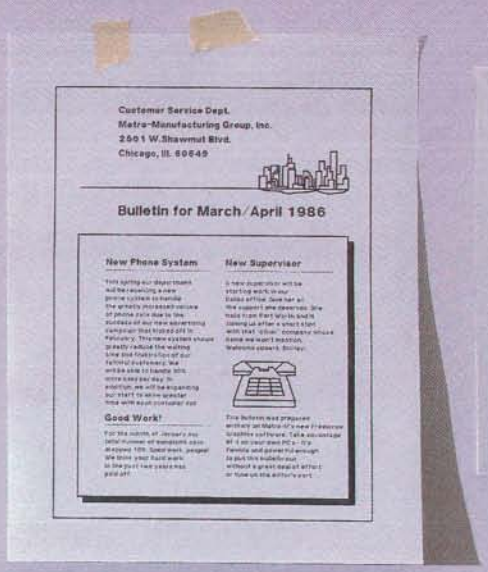
See your local authorized Lotus dealer for a complete Freelance Plus demonstration. To order a $10.00 demonstration package, call *1-800-345-1043* and ask for YM-1658.

Lotus Freelance Plus

The one graphics product for presentations, reports and everyday business communications.

© 1987 Lotus Development Corporation. Lotus, 1-2-3, Symphony, Freelance and Graphwriter are registered trademarks of Lotus Development Corporation. Lotus Manuscript is a trademark of Lotus Development Corporation. dBase is a registered trademark of Ashton-Tate.

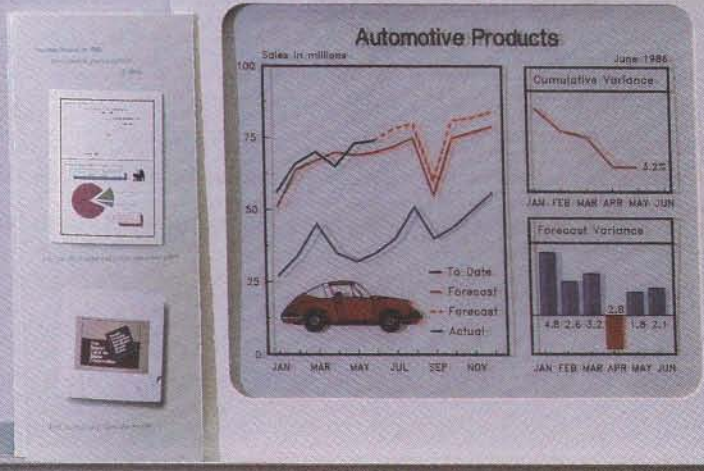






One Program
charts, symbols
diagrams, etc., etc.

overheads
+ slides, too.





Features

Product Preview:
The Commodore A2000
by Gregg Williams, Tom Thompson, and Richard Grehan 84

Product Preview:
Turbo BASIC
by George A. Stewart 101

Ciarcia's Circuit Cellar:
Build a Trainable Infrared Master Controller
by Steve Ciarcia 113

Programming Insight:
Building a Random-Number Generator
by Brian Wichmann and David Hill 127

Programming Project:
Installing Memory-Resident Programs with C
by Brian Edginton 129

THIS MONTH'S FEATURES SECTION offers two product previews. In the first, BYTE technical editors Gregg Williams, Tom Thompson, and Richard Grehan give us an advance look at Commodore's new Amiga, the A2000. They believe this new model will make accessible much of the potential that was locked inside the A1000. Its most exciting feature is the optional A2088 board that gives it IBM PC compatibility. A complete review will follow in an upcoming issue.

Next, BYTE technical editor George Stewart gives us a preview of Turbo BASIC, Borland International's answer to Microsoft BASIC. It offers 8087 compatibility, fast and versatile compilation, recursion, and it's BASICA-compatible.

Although this month's Circuit Cellar is not the second part of a two-part article, it does relate to last month's project, which was an infrared remote control for Steve's home control system. The infrared Master Controller takes charge of all your home entertainment equipment. It "learns" the infrared signals for each function and plays them back on command. Commercial units now available have two shortcomings: First, the necessary circuitry is contained in a single hand-held unit; second, they are not user-programmable. Steve designed the Master Controller to avoid these shortcomings.

In our Programming Insight, "Building a Random-Number Generator," Brian Wichmann and David Hill caution against relying on built-in random-number generators, which do not always produce sequences that will stand up to severe tests. The authors present a Pascal routine that combines three simple generators into one that produces satisfactory statistical results.

Although techniques for making an assembly language program stay resident are common enough, making a C program resident, according to Brian Edginton, is a new adventure. In our Programming Project, he explains how he used C to write a simple interrupt-processing program that remains resident in memory.

Gregg Williams, Tom Thompson, and Richard Grehan

The Commodore A2000

The new machine features slots and optional PC compatibility

Editor's note: *The following is a BYTE product preview. It is* not *a review. We provide an advance look at this new product because we feel it is significant. A complete review will follow later.*

When Commodore released the first Amiga computer, the A1000, in September 1985, the world got a look at a sophisticated 68000-based computer whose unusual multitasking hardware and stunning graphics had never been seen in an under-$1500 microcomputer (see the August 1985 BYTE for more details). Even though it did have a connector on its side that allowed future hardware expansion, the A1000 was essentially a "closed box," and many potential users felt the machine was limited as it stood.

Now, with the new Amiga 2000 (see photo 1), Commodore has made accessible much of the potential that was locked inside the A1000. With a larger case that can enclose hard disks, Amiga and IBM expansion cards, the A2088 board (the one-card equivalent of an IBM PC), and a price tag of under $1500 (for the basic machine with 1 megabyte of memory and an 880K-byte 3½-inch floppy disk drive), the A2000 has the potential to grow—and grow inexpensively—in whatever direction you want. The A2000 will suit the engineer, artist, and businessperson better than the A1000 ever could.

System Description

The A2000 comes in a metal housing of approximately the same width as the A1000 but several inches deeper and substantially taller to accommodate internal peripheral boards. You'll immediately notice knock-out front panels for an additional 3½-inch floppy disk drive and either a 5¼-inch floppy disk drive or hard disk drive. The mouse ports have moved from the right side of the housing to the bottom front panel on the machine. The detachable keyboard now plugs into the front with a PC-style keyboard connector, rather than to the rear of the unit as on the Amiga 1000.

If you check the In Brief section for the A2000 with the A1000's hardware specifications, you'll see that they're quite similiar: a 68000 CPU running at 7.14 MHz with the same three custom chips handling video, DMA, sound, and I/O (see figure 1). But here the similarities end: The Amiga 2000 has a battery-powered calendar/clock, 1 megabyte of RAM, and a built-in expansion bus with slots. Also, the latest version of the low-level system routines are in ROM, eliminating the Kickstart disk required to load these routines into write-controlled storage RAM as you do on the Amiga 1000. See the text box "Version 1.2 Changes" for additional information on modifications to the system routines and Workbench.

The A2000 serial and parallel ports accept standard cables, eliminating the cabling nightmare of the A1000 caused by the voltages that were present on some of the pins. There's an external drive connector as on the A1000, but the RCA jack for composite video output is gone (see photo 2).

Keyboard

The keyboard (photo 3) now has 94 keys instead of 89. New keys include Help, Enter, and math keys (+, −, *, /) for the numeric keypad. The cursor keys are arranged in a "T" fashion instead of a cross. The keyboard has full *n*-key rollover capability, which eliminates a "ghosting" phenomenon (extra keycodes that are generated if several keys are pressed simultaneously) that is present in the A1000 keyboard.

Slots

Unlike the A1000, which is equipped with only a single external edge connector, the A2000 comes with seven internal slots for peripheral cards. Five slots use the Amiga system bus, and four slots are on a secondary bus that is IBM XT-compatible. (Commodore has also added 36-pin connectors for potential IBM AT compatibility in the future.) The slots total seven because two pairs of slots—a pair being one slot on the Amiga bus and one slot on the secondary system bus—are physically situated to serve as bridges for Amiga/PC data communications (see photo 4). The Amiga 2088 card (described later) resides in one of these "bridge" slots. You can plug the 2088 card into either bridge slot depending on your needs. If PC emulation is your major concern, you will want to position the 2088 card so that three of the four PC bus slots are available for peripheral cards. Or you can position the card to permit the use of four out of five Amiga bus slots.

There is an 86-pin slot for access to the Amiga CPU bus called the CPU bus slot. This slot taps directly into the unbuffered signals from the Amiga's CPU and is identical to the external slot on the Amiga 1000. It can be used for special peripherals, such as a coprocessor, that need to be tightly coupled to the CPU.

Finally, there's a slot provided for the support of either NTSC or PAL composite video boards. Since the A2000 does not produce a composite video signal (as the A1000 did), you must insert a composite

continued

Gregg Williams, Tom Thompson, and Richard Grehan are technical editors at BYTE. They can be reached at One Phoenix Mill Lane, Peterborough, NH 03458.

PHOTOGRAPHS BY PAUL AVIS



Photo 1: *The Amiga A2000 computer. The A2000 comes with 1 megabyte of memory and one 3½-inch floppy disk drive. You can also substitute internal hard disks for the second (left) 3½-inch and the 5¼-inch drives that are installed in this machine. The image of the IBM PC shown on the screen was captured using NewTek's Digi-View software.*

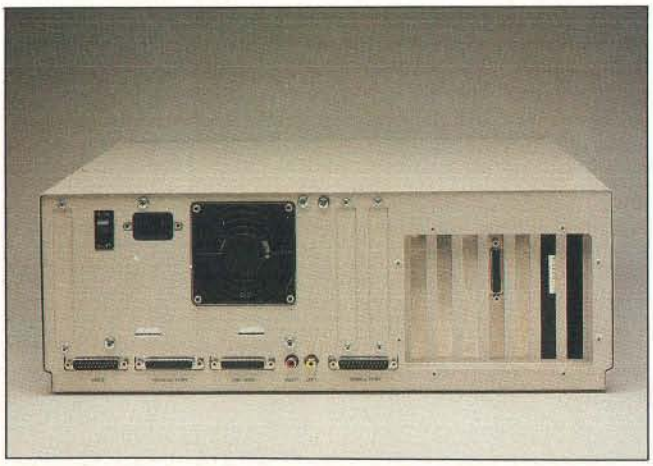


Photo 2: *The A2000 back panel. Notice the cutouts for outputs from peripheral cards.*



Photo 3: *The A2000 keyboard. All the keys on the keypad are labeled on their front face with the IBM PC–related functions associated with them.*

IN BRIEF

Company
Commodore International
1200 Wilson Dr.
West Chester, PA 19380
(215) 436-4200

Price
$1499

Microprocessor
Motorola 68000 7.14-MHz, 16-/32-bit microprocessor

Main Memory
1 megabyte RAM standard, expandable up to 8 megabytes using AutoConfig
256K ROM containing 192K bytes of system code

Disk Memory
880K-byte 3½-inch double-sided floppy disk drive

Keyboards
Detachable 94-key keyboard, with 10 function keys, separate numeric keypad, separate cursor keys
Detachable 96-key keyboard, international version

Pointing Device
Optomechanical two-button mouse

Ports
RS-232C serial port, PC-compatible
DB-25 parallel port, PC-compatible
DB-23 RGB video port
External disk drive port
Two RCA jacks for stereo sound
Two DB-9 joystick ports (one port used for mouse)

Miscellaneous
Three custom chips provide graphics, DMA, video, and sound; built-in battery-powered calendar/clock

Optional Peripherals

Internal 3½-inch floppy disk drive	$199
Internal 5¼-inch floppy disk drive	$299
A2088 PC coprocessor card	$499
A2050 2-megabyte expansion memory card	$499
A2060 Composite video interface card	$99
A2094 Hard disk/SCSI controller card	$349
A2002 color monitor (analog RGB)	$349
A2080 color monitor (long-persistence phosphor, analog RGB)	$499

video card in this slot to generate the required signal.

Buses

Data traffic among the slots and the CPU is handled by three distinct buses (see figure 2).

The CPU bus consists of 86 lines, some of which are connected directly to the 68000 CPU. There are no buffers between the CPU and the CPU bus slot.

The PC bus is a 62-line IBM XT bus. A peripheral board—such as the A2088 board—is required to allow the Amiga to communicate to this bus.

The Amiga bus consists of 100 lines that carry CPU and other signals that handle external interrupts and bus arbitration logic. These lines are buffered, which simplifies the task of designing the interface for a peripheral board. It must be noted that several of the Amiga bus signals are not identical to the 100-line expansion bus on the Zorro backplane. (Zorro is a bus card that extends the external slot for the A1000 by allowing for five plug-in boards. See table 1 for further information.) Additionally, the required form factor for the boards has changed: The square Zorro boards will not fit in the space provided for the rectangular A2000 boards.

AutoConfiguration

You encounter a problem when you include slots in a microcomputer: How do you make sure that all the peripheral boards will interact properly on the bus? For the Amiga, an AutoConfiguration protocol (referred to for the remainder of this article as AutoConfig per the Commodore documentation) is used to ensure that all peripheral boards are installed into the system at boot-up. This AutoConfig protocol is provided by version 1.2 of the system software and is manipulated via two lines on the Amiga bus ($\overline{\text{CONFIG-IN}}$ and $\overline{\text{CONFIG-OUT}}$).

At power-up or reset, all peripheral boards are in an unconfigured state. The $\overline{\text{CONFIG-IN}}$ line goes low to the first peripheral board on the bus, allowing it to respond to bus cycles. The processor reads signature data from the peripheral board. This data informs the configuration software of the size of the board's address space, whether initialization code must be run to complete the configuration of this board, the manufacturer's serial number, and whether the board is to be added to the Amiga's free memory pool (if this peripheral is a memory board). With this information, the Amiga now computes how much address space this board requires and writes a base address to its address latches. The board will respond to bus accesses at this new address until a reset occurs. The Amiga also runs any initialization code that the board requires.

Once the board has been configured into the Amiga's address space, it lowers $\overline{\text{CONFIG-OUT}}$, allowing the next board on the bus to respond to the processor. This signal is passed along, daisy-chain fashion, as each board is configured on the Amiga bus.

In the event board initialization fails, the software can issue a write to an optional "shut up" address that is provided in the board signature data. Writing to this address causes the board to lower its $\overline{\text{CONFIG-OUT}}$ line and never respond to any address until the system is reset. This allows the AutoConfig sequence to proceed while removing any malfunctioning boards from the system.

The CPU bus slot does not support the AutoConfig protocol. However, there is special code in Kickstart to detect and determine the capacity of any memory board that may be installed in this slot.

Fast and Chip Memory

Memory boards placed on the CPU bus or Amiga bus have the advantage of being *fast* memory. Fast memory is RAM that does not have to share bus access with the custom blitter chip that manages the video display. RAM that the blitter chip can access is called *chip* memory. The blitter operates at a higher priority than the 68000 and steals bus cycles when necessary to maintain the display. This results in contention for chip memory access between the CPU and blitter. Programs normally have to run in chip memory on the A1000 because all of the 512K bytes of internal RAM are chip memory. On the A2000, half of the megabyte of RAM is fast memory; this should result in an increase in program performance. Since an image must be located in chip memory for the blitter to display it, locating program code in fast memory also allows more images to be placed in chip memory.

Amiga 2088 Board Hardware

Simply put, the A2088 board is a modified IBM XT-compatible computer on a single 13.25- by 4.5-inch card (see photo 5). Its microprocessor is an 8088 operating at the standard 4.77-MHz clock rate. A 16K-byte EPROM provides a BIOS with modifications by Commodore that supply routines necessary for communication between the 8088 and the Amiga. The A2088 can accept up to 512K bytes of RAM on board (it will be shipped with 512K), not counting 128K bytes of dual-port RAM used for interprocessor communication. A socket adjacent to the 8088 chip allows you to add an 8087 math coprocessor chip. Additionally, the A2088 card is equipped

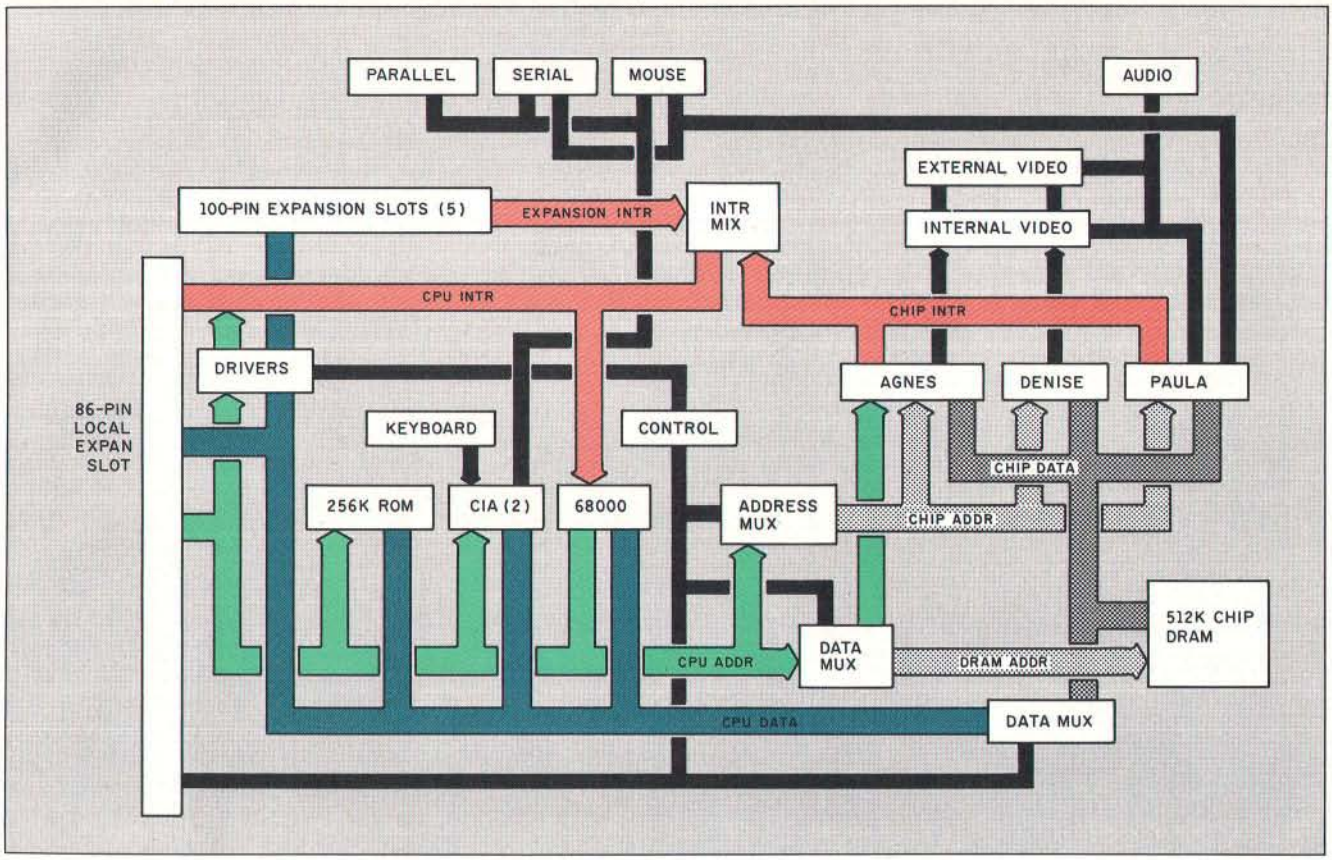


Figure 1: *A detailed block diagram of the Amiga 2000.*

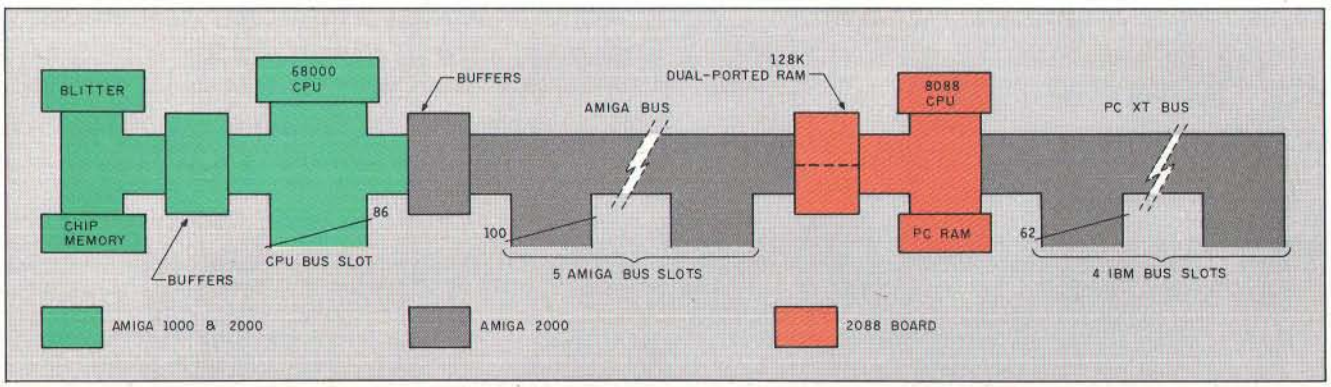


Figure 2: *A simplified block diagram of the Amiga 2000 with the Amiga 2088 board installed. The CPU bus slot, Amiga bus slots, and PC bus slots can operate without interfering with the blitter chip.*

with an SMC 9268 floppy controller chip and a standard 5¼-inch floppy connector; this permits you to connect up to two 5¼-inch drives in daisy-chain fashion—one external and one internal.

What makes such complexity possible on a single board? The answer is a custom integrated circuit that Commodore refers to as the PC Multifunction chip. This single chip does the work of a DMA controller, an interrupt controller, and a timer as well as providing all the PC bus timing signals. An 8088 wired to a PC Multi-

continued

Table 1: *Differences between the 100-pin Zorro expansion bus and the 100-pin Amiga bus.*

Pin number	Zorro signal	Amiga bus signal	Comment
19	$\overline{\text{INT2}}$	$\overline{\text{EINT2}}$	Name change
22	$\overline{\text{INT6}}$	$\overline{\text{EINT6}}$	Name change
40	$\overline{\text{IPL0}}$	$\overline{\text{EINT7}}$	Signal change
42	$\overline{\text{IPL1}}$	$\overline{\text{EINT5}}$	Signal change
44	$\overline{\text{IPL2}}$	$\overline{\text{EINT4}}$	Signal change
92	7M	$\overline{\text{7ME}}$	Name change
96	RESERV7	$\overline{\text{EINT1}}$	Signal change

function chip and some memory would make a complete PC, less peripherals.

The A2088 card has two edge connectors, one PC-compatible connector that plugs into a slot on the PC side of the A2000, and a 100-pin slot for the Amiga bus side. Consequently, you insert the A2088 board into one of the two bridge slots. The PC-side edge connector drives PC bus signals and provides A2088 with access to peripherals plugged into the other PC card slots. The Amiga bus edge connector is the means by which the A2000's 68000 processor accesses the A2088's dual-port RAM. This RAM is designed to be accessible by both the PC and Amiga sides of the machine.

Some additional hardware on the A2088 board deceives the PC side of the A2000 into believing that it is indeed a PC. For example, the PC Multifunction chip expects to be connected to a standard PC keyboard (which communicates through a synchronous serial interface), but the A2000's keyboard is not PC standard, nor is it connected directly to the A2088 board. So the designers of A2088 added a parallel-in/serial-out shift register and some clever software. When a key is pressed on the keyboard, it is translated (on the Amiga side) into its PC keyboard equivalent and this value is loaded into the dual-port RAM. The Amiga side then alerts the A2088 board to the presence of the key value, software on the A2088 board transfers the value from dual-port RAM to the shift register, and the key value is transmitted serially into the PC Multifunction chip looking as though it has just come hot from a keyboard.

Amiga 2088 Card Software

How does the A2088 board coexist with the Amiga? In general, each computer responds when the other sends it an interrupt. Hitting a key on the Amiga sends an interrupt to the A2088. This triggers an interrupt service routine on the A2088 that feeds the board's hardware with a keystroke exactly as if it had been typed into a keyboard on the PC side. When the A2088 draws to either the graphics or monochrome display memory, it sends an interrupt to the Amiga, which then looks at the A2088's video display memory (part of the dual-port RAM) and determines what and how to draw on the Amiga screen.

When you click on the "PC Mono" or "PC Color" icons, these programs run a program called PCWindows. PCWindows opens a screen and a window in which the A2088-generated information will appear. The A2000 sees the 2088 board as a peripheral device and looks for its associated library routines on the default disk. PCWindows (or any other Amiga program) then has access to a collection of routines that allow it to interact with the 2088 card's hardware in a way that is both high-level and unchanging; this allows Commodore to modify the actual Amiga 2088 card's hardware or the library software without affecting existing software.

The PCWindows program starts several Amiga tasks (remember that the Amiga itself is multitasking) that are awakened by the interrupts from the PC as described above. Actually, an interrupt causes the Amiga to send an exec signal to the task. In this way, an Amiga programmer does not have to deal directly with interrupts.

Dual-Port Memory

The Amiga and the PC sides of the computer need to be able to read from and write to the dual-port memory quickly, yet each machine's architecture presents different needs. For example, the 8088 processor stores a 16-bit quantity in low-byte-first order (i.e., with the least significant byte stored at a lower address), while the 68000 processor in the Amiga stores a word with its high byte first. Also, the PC stores a color pixel as 2 adjacent bits within the same byte of color graphics video memory, while the Amiga stores the 2 bits in separate bytes.

The engineers who designed the Amiga 2088 card came up with an elegant but convoluted solution. On the PC side (with one exception), each word of memory maps to one location. The Amiga side can reference a given chunk of memory in three ways, using three different locations. It uses one address to access a byte of memory, another to access a word of memory, and a third to access 2 bytes of color video memory (see figure 3). In the second case, the 2 bytes of the word are read on the Amiga side in the opposite order of how the PC side sees them.

In the third case, the word of data read by the Amiga side contains the first bit of each of the 8 pixels involved in the first byte and the second bit of the pixels in the second byte (see figure 4). This interleaved access makes the PC's 320 by 200 four-color mode possible. The A2088 card also supports a 640 by 200 one-color mode, but since each pixel is defined by one bit, no such bit manipulation is needed.

In other words, the Amiga and the PC see the same memory differently depending on what memory location the Amiga side uses to access it. By putting these functions in hardware, the Amiga and the PC can run their usual software without having to worry about data conversion or, more importantly, the time it might take to perform such conversions.

continued

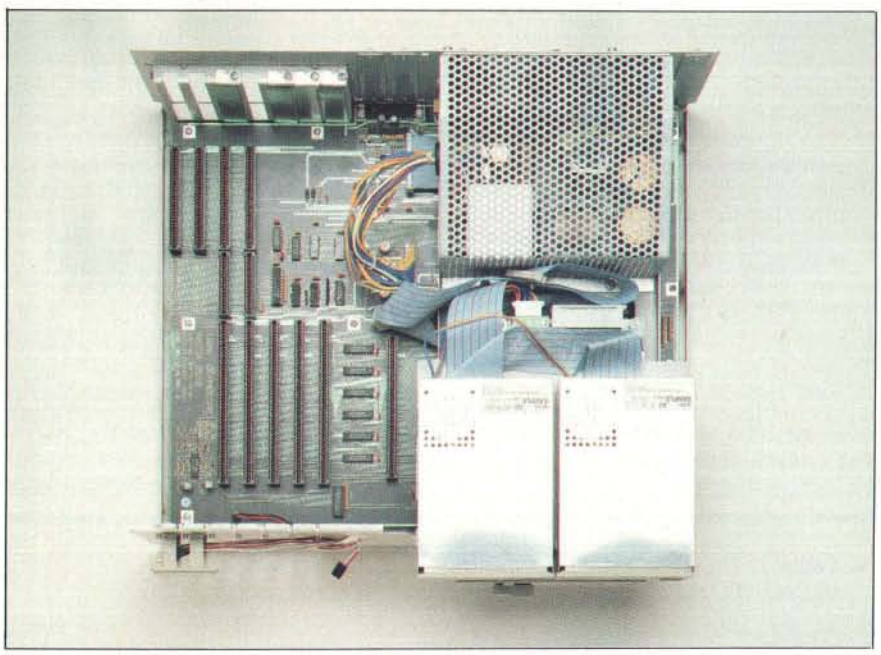


Photo 4: *Inside the A2000. Note the slots in back (top) and the two floppy disk drives in front (lower right). The CPU slot is directly to the left of the disk drives. The five connectors in the bottom left corner are the five Amiga slots. The four connectors in the upper right corner are the four PC slots; two can hold standard IBM PC cards, and two can hold IBM AT cards. The 2088 PC emulator card must go in one of the two slots that have PC and Amiga connectors in common. The video slot is in the upper right corner but is not visible in this photo.*

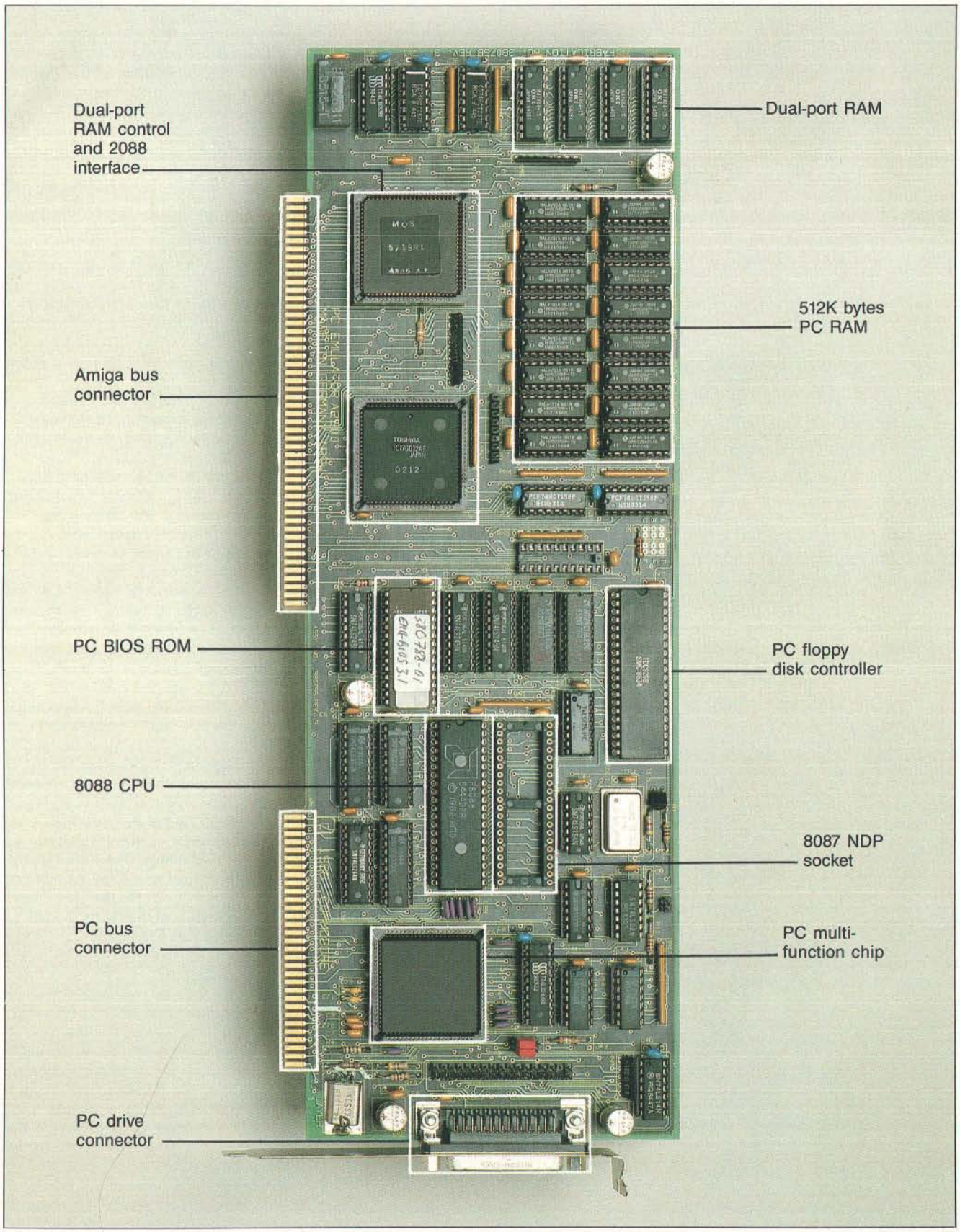


Photo 5: *The A2088 PC emulator board. This board contains the 8088 processor, memory, ROM, and support chips of an IBM PC–compatible computer and correctly uses any PC peripheral cards connected in the PC slots.*

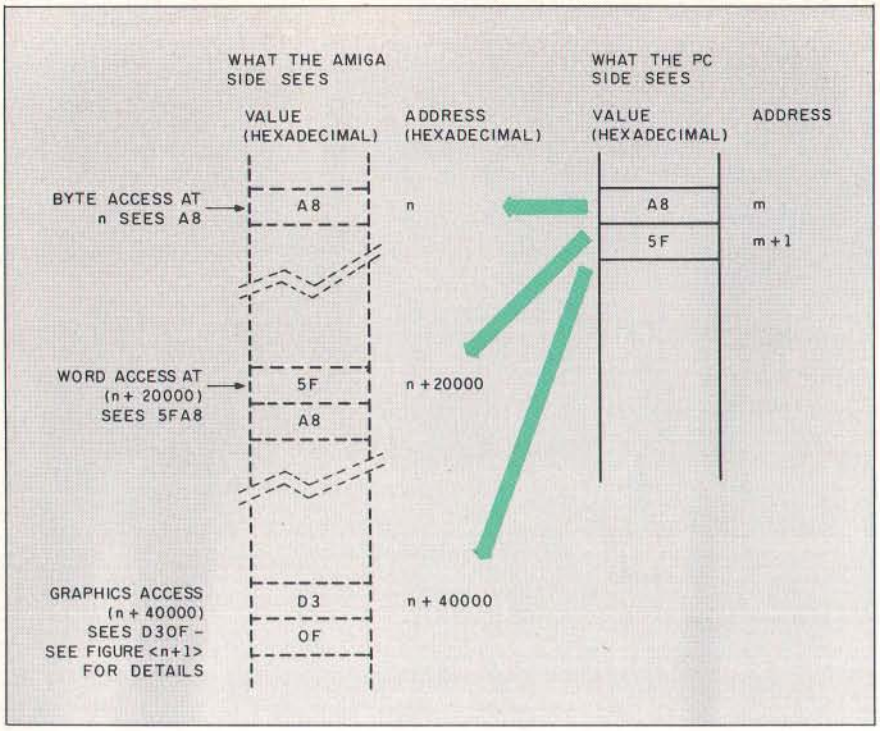


Figure 3: *Three modes of access for the Amiga 2088 board's dual-port RAM. Though each memory location in the dual-port RAM has only one address on the PC-compatible side, it appears at three different locations in the Amiga's address space. The dual-port RAM maps the bits to the Amiga side in a different order based on the location accessed.*

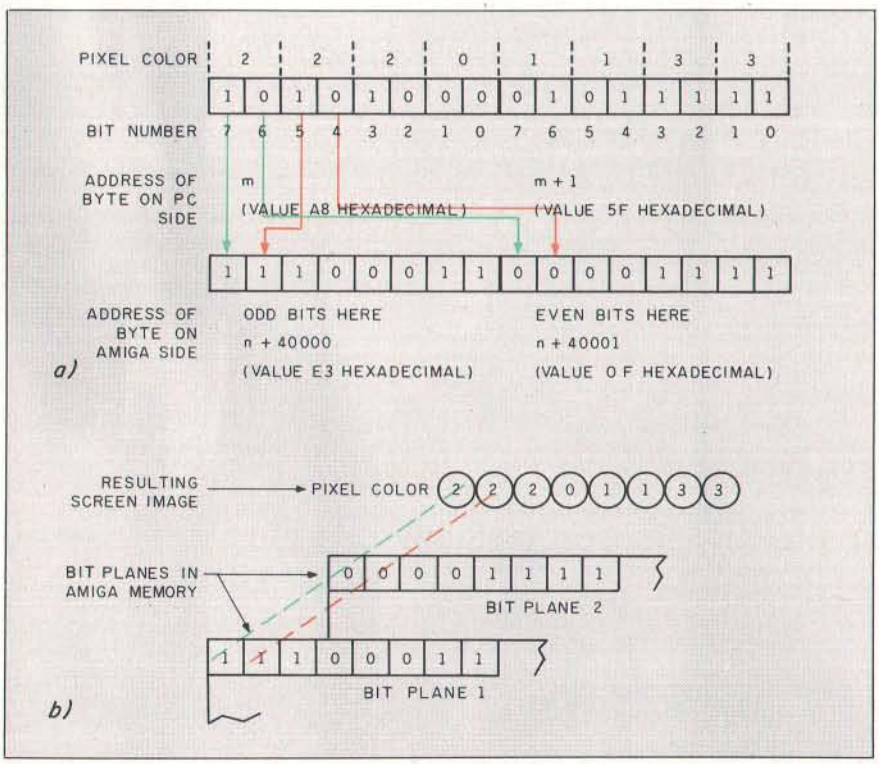


Figure 4: *Graphics access of the dual-port RAM. Two adjacent bits on the PC side make up a pixel, but these bits must be in different bit planes to recreate the same pixel on the Amiga side. Figure 4a shows how 2 bytes on the PC side (top) are mapped into the Amiga side (bottom). Figure 4b shows how the 2 bytes on the Amiga side are placed in different bit planes to recreate the pixel pattern created on the PC side.*

Different portions of the dual-port memory are reserved for specific usage. A 64K-byte area is used as a general-purpose buffer (most often used to transfer disk sectors between the two machines), 32K bytes are used for the PC's color video memory, and 8K bytes are used for its monochrome (character) video memory.

A 16K-byte area is called parameter RAM. This memory serves two functions. First, both computers use one byte of it, called the lock byte, to signal if they are about to reserve part of the general-purpose buffer for their use (which they release as soon as they are finished with it). It is possible that the two independent computers might try to allocate the same memory simultaneously. By checking the lock byte until it has an "unused" value, setting it to a "used" value, allocating memory, then restoring the "unused" value, the two computers can successfully share the dual-port memory.

The parameter RAM's second function is to store blocks of parameters that one computer sets and the other computer reads. For example, when the Amiga wants to transfer a block of data to the PC side, the data is passed through an area of the general-purpose buffer, but the parameter RAM contains information necessary to perform the transfer: the location and length of the data and the desired destination for it on the PC side.

The final 8K-byte area of the dual-port RAM is called the I/O page RAM. On the Amiga side, this memory maps to a certain range of addresses, while on the PC side it corresponds to a standard set of I/O register locations on the PC that are used to control the serial and parallel ports and the PC's monochrome and color CRT controller. In some cases, these locations are the registers. In others, they duplicate the value of the register, and the Amiga can read its value but not change it; in these cases, the dual-port memory is said to *shadow* the register.

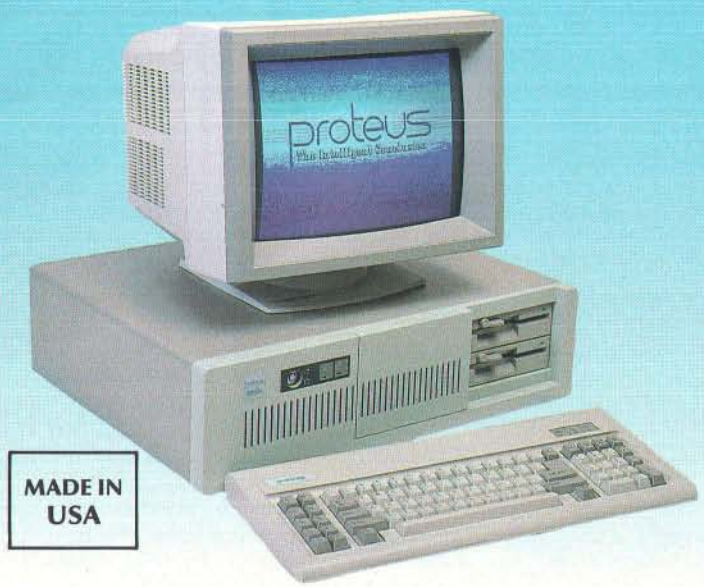
PC Video Display

Now that we have an overview of how the Amiga and the A2088 talk to each other, let's look at some specific situations. A monochrome (character-based) or color (character- or graphics-based) video display gets from the A2088 to the Amiga's display as follows. When a program running on the PC side outputs data to the screen, the BIOS screen I/O routines write information into the monochrome or color video memory portion of the dual-port RAM. The act of writing to this memory generates an interrupt from the A2088 to the Amiga. The Amiga recognizes this as a video memory interrupt and "wakes up"

continued

proteus™

There are plenty of clones but none can match PROTEUS in IBM compatibility, speed, reliability, support & delivery.



MADE IN USA

PROTEUS features include:

12.5Mhz CLOCK SPEED
4MB RAM ON BOARD
8 LAYER STABLE MOTHERBOARD
3 SERIAL PORTS,
2 PARALLEL PORTS STANDARD.

EDITOR'S CHOICE.

"There are so many nice aspects to Proteus 286 and the company that makes it, there is not enough room to cover them all."

EDITOR, BUSINESS COMPUTER DIGEST.

- **30-DAY FULL MONEY-BACK GUARANTEE (TOTAL SATISFACTION GUARANTEED)**
- **FREE NATIONWIDE ON-SITE MAINTENANCE**
- **15-MONTH FULL WARRANTY**
- **UNIQUE, BUT FREE 24-HOUR ONLINE TECH SUPPORT**

100% compatibility with AUTOCAD, NOVELL, UNIX, ZENIX

High quality manuals & utilities

PROTEUS-286/PROTEUS-286 GT
(A high performance AT engine) compare our features!

80286-10 Intel CPU
6/10, 6/12.5 MHz opt.
(Keyboard, software & hdwre selectable)
8-layer stable motherboard
1024K RAM expandable to 4MB on mainbd
8 I/O slots
80287 coprocessor socket
3 serials, 2 parallels on mainbd
0 wait state opt.
5 MHz DMA bus
Hard disk & floppy controller
Clock, cal. & battery backup
Two floppy drives; 1-1.2MB & one 360K with choice of 3.5" drive
High quality AT keyboard
Price $2195.00
Made in USA
With High Resolution Monitor and Herc. compat. graphics card **$2395**
Custom configurations available.

12.5 MHz, 44 Megabyte EGA system $3695

Intel 80286-10 running at 12.5/6 MHz
8-layer stable motherboard
80287 coprocessor socket
1.2MB floppy drive
5Mhz DMA bus
1024K expandable to 4MB on motherboard
8 I/O slots (2, 8bit, 6, six bit)
3 serials, 2 parallel built-in
clock/cal., battery backup
200W power supply
combined hard disk & floppy controller
AT-style keyboard
44MB high speed (28ms) hard disk installed
High Quality EGA card
High Quality EGA Monitor
Made in USA

PROTEUS-286E/1800 AT $1495

6/8/10 Mhz AT
80286 Intel CPU running at 10Mhz
1024K RAM
8 I/O slots
2 serials, 2 parallels
80287 coprocessor socket
Hard disk & floppy controller
1.2MB floppy drive
Maxi Switch AT keyboard
195W power supply
Hercules Compatible Monochrome card
High Resolution Monochrome Monitor
20MB hard disk installed. Full System $1795
Made in USA

10 MHz, 44Megabyte EGA system $2795

Intel 80286 running at 10Mhz
1024K on the motherboard
8 I/O slots
1.2MB floppy drive
Combination hard disk & floppy drive
80287 coprocessor socket
2 serials, 1 parallel
Clock/cal., battery backup
195W power supply
Maxi Switch AT keyboard
Proteus EGA adapter
EGA monitor
44MB high speed hard disk installed
Made in USA

proteus™
The Intelligent Conclusion



WE HAVE THE LARGEST SELECTION OF HARD DISKS, MONITORS AND ADAPTERS AT LOWEST PRICES. WE INTEGRATE AND TEST THE SYSTEMS EXTENSIVELY.

HARD DISKS

20 MB Seagate	$285
30 MB Seagate	$595
44 MB Miniscribe	$665
72 MB Miniscribe	$995
80 MB Seagate	$1095
120MB Seagate	$call

MONITORS

High Res. Monochrome	$109
13" color monitor	$310
Sony Multiscan	$call
Nec Multisync EGA	$569

ADD-ONS

Hercul. compat. mono card	$109
4MB upgrade to Proteus	$call
80287-8	$129
80287-10 (runs at 10Mhz)	$call
STB Plus EGA card	$295
Wonder EGA card (ATI)	$345
Vega Delux	$345
Proteus EGA Card	$245
1200/2400B Modem	$345
Floppy Drive	$109
20 MB Tape Backup	$485
All other items	$call

TO ORDER OR FOR INFORMATION CALL US DIRECT:
201-288-8629

Proteus Technology Corp
377 RT 17
Airport 17 Center
Hasbrouck Heights, NJ 07604
TELEX 510 601 0960
FAX 201-288-2577
Overseas: Proteus, W. Germany, Proteus, France

Inquiry 331

The reality of the PC world is that no area is always empty in every possible PC configuration.

a task that compares the contents of the dual-port video memory with what currently appears in the active PC window on the Amiga display. This task is *smart*: It knows the current contents of the Amiga display and updates only those portions that have changed. This makes, for example, the addition of one character to the display a pretty quick process, much quicker than updating an entire screen.

If the PC is currently in the monochrome display mode (which, on the PC side, stores the screen as a matrix of ASCII values), then the video display task must convert that character to a rectangular matrix of bits and paint them to the Amiga display. To do this, the Amiga refers to a file called PCFONT.FONT that describes the bit patterns of the IBM monochrome character set (ASCII characters plus additional characters defined by IBM). If the character being drawn has a background color other than the default, the Amiga monochrome video display task has to draw an image into several Amiga display bit planes.

The Case of the Nine-headed Buffer

It turns out there are not three but nine sets of addresses for the 64K-byte general-purpose buffer memory. Three of them come from the need to address the memory in byte, word, and graphics modes. Where do the rest come from?

The answer lies within the structure of the IBM-compatible PC. The first 640K bytes of memory (hexadecimal 00000–9FFFF) are reserved for programs. This means that areas like the video memory, PC BIOS, ROM BASIC (for IBM PCs), and the ROM code associated with certain expansion cards must live in the space between hexadecimal A0000 and FFFFF. In the Amiga 2088 card, the 64K dual-port buffer memory must also reside somewhere in that space.

The reality of the PC-compatible world is that no area is always empty in every possible PC configuration. The 64K areas starting at hexadecimal A0000, D0000, and E0000 are most likely to be free. Therefore, the Amiga 2000 engineers designed the 64K area to map (on the PC side) to one of these three areas so as not to conflict with the hardware and software you will be using with the Amiga 2088 card. (This option can be selected from the Amiga Workbench screen.) Consequently, any byte within this 64K region can map to one of three address ranges on the PC side, and each range can be accessed on the Amiga side from three separate ranges.

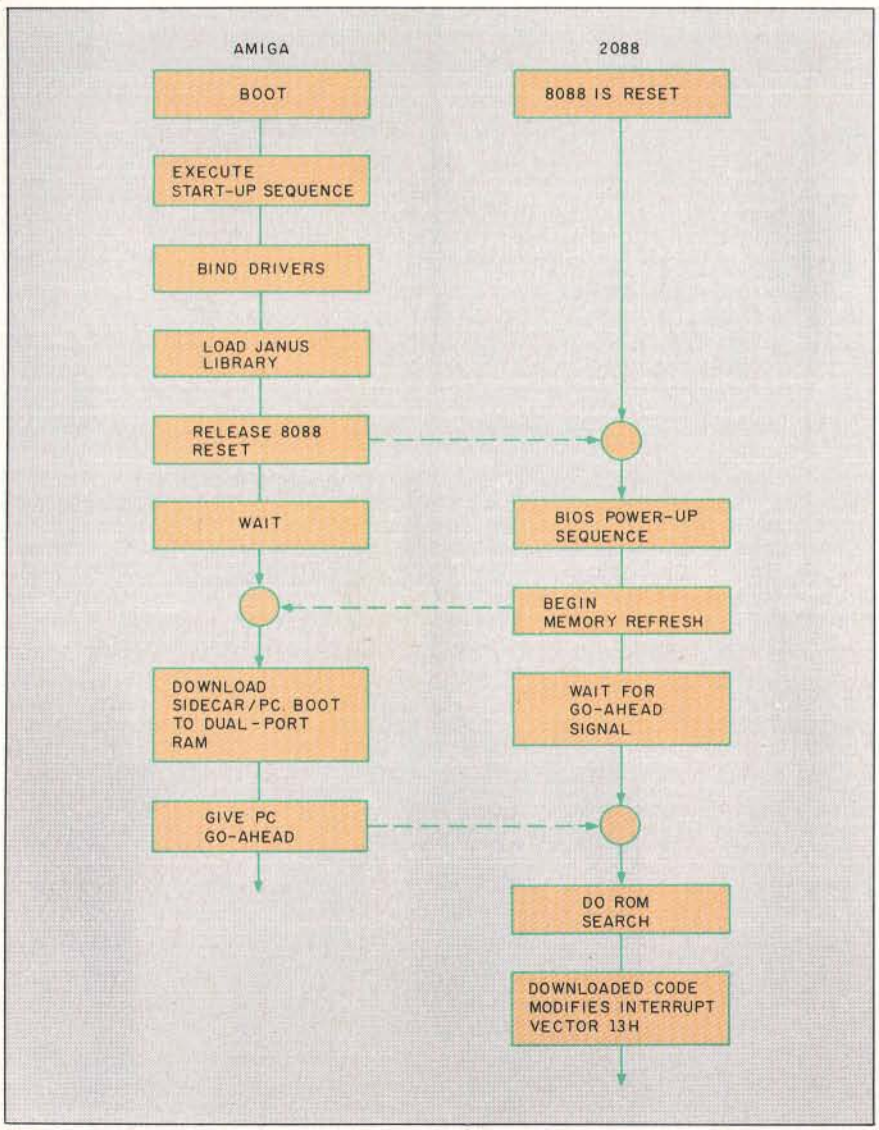


Figure 5: *The sequence of events necessary to boot the A2088 board with the Amiga 2000.*

Accessing a Hard Disk

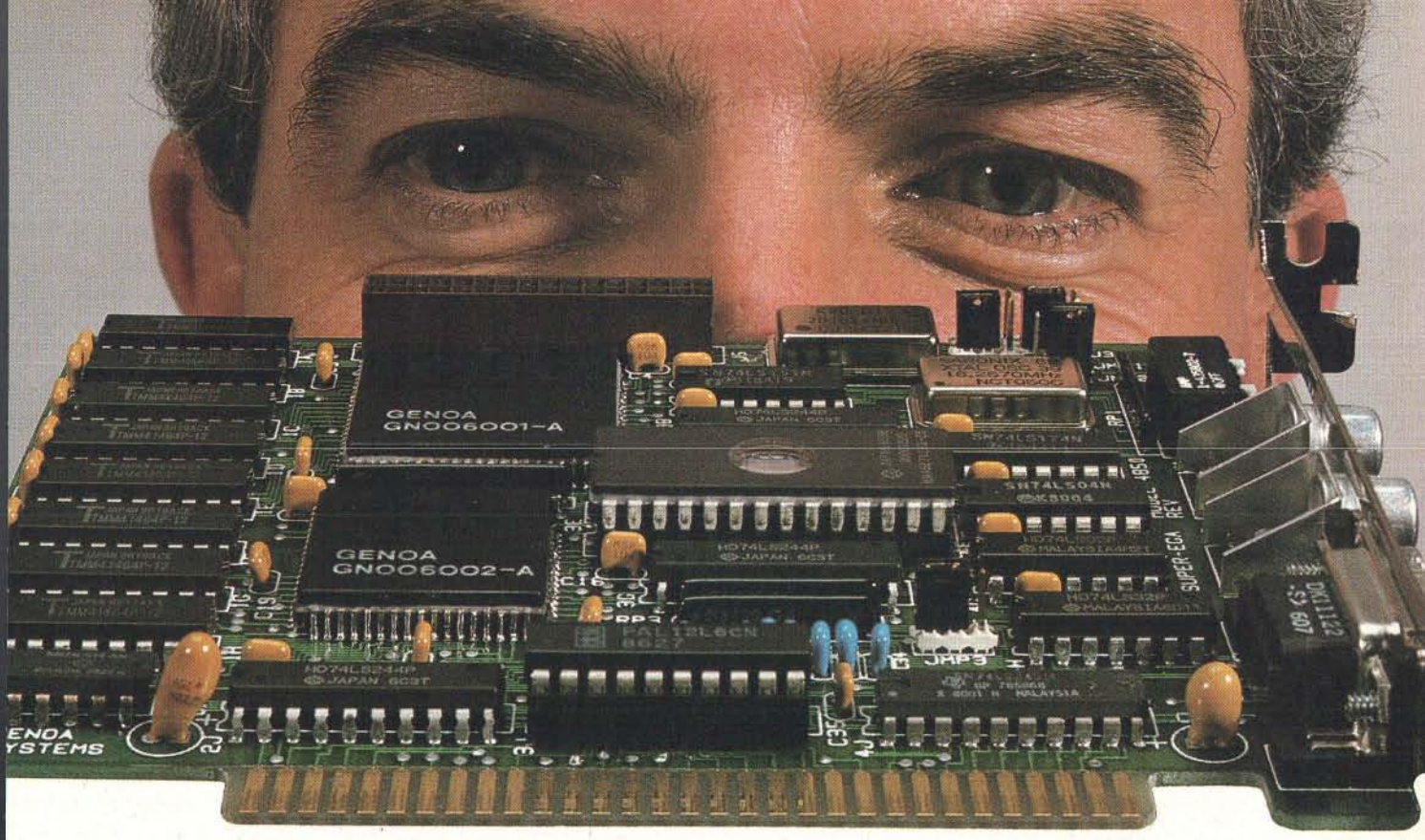
Commodore has designed the Amiga 2088 board so that the Amiga side of the A2000 can access a partition of a hard disk on the PC side. You run the usual FDISK program on the PC side to allocate part of the hard disk for the PC. Commodore has provided a similar program called ADISK that you run to create an AmigaDOS partition on the hard disk.

On the Amiga side, this partition of the PC hard disk appears as JH0: and can be treated like any other Amiga disk (although you cannot use it to boot up the system—you must boot from the floppy disk in DF0:). JH0: has its own device driver that uses the dual-port memory and an interrupt mechanism to get (or put) file sectors to the hard disk.

How do the two sides of the machine establish and coordinate conversation with one another? To answer this with an example, let's suppose you have a PC-compatible hard disk whose controller is plugged into one of the PC slots. We'll follow the processes that take place when you power on the A2000 (refer to figure 5).

When power is applied to the system, the 8088 on the A2088 board is immediately placed in a RESET state. Basically, this keeps the processor from running

continued



For Real EGA Compatibility, Come to Our Level.

Our Super EGA™ board is compatible all the way down to the chip register level —so compatibility is embedded in the hardware, not in the software like most EGA boards. And these chips are special: they're our own proprietary VLSI design.

- Requires no software emulation.
- 100% compatible with EGA, CGA, MDA, Hercules, TGA (640 x 400) and PGA (640 x 480).

Super Speed

- Genoa's chip set and Super BIOS™ make this one of the fastest graphics cards made.
- Operates with 4.77, 6, 8, 10, 12 or 16 MHz CPUs—with higher speeds on the way.

Super Resolution

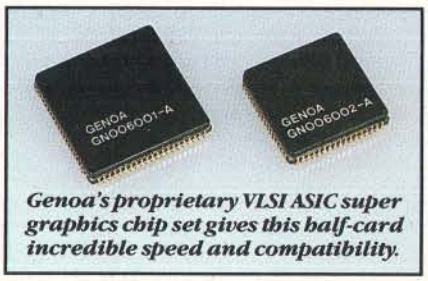
- In EGA mode: 132 x 44, 32, 29 and 25.
- Up to 1056 x 352 pixels.
- Supports highest resolution available today (PGA).
- Displays 3270 format (Models 2, 3, 4 and 5).

Super Reliability

- Low-power CMOS VLSI chip set assures long life.
- Our dealers will tell you: our boards are the most reliable on the market!

Super Driver

- Genoa's software driver for Lotus and Symphony spreadsheet applications makes the Super EGA board a clear winner. All 132 columns are displayed on the screen at once.



Genoa's proprietary VLSI ASIC super graphics chip set gives this half-card incredible speed and compatibility.

Super OEMs Wanted

In addition to the ready-to-use half card, Genoa offers the custom board designs and the advanced CMOS VLSI Super EGA chip set to OEMs. Call for details.

For more information on Genoa's Super EGA board, call us at 408-432-9090, or write: Genoa Systems Corporation, 73 E. Trimble Road, San Jose, CA 95131.

Genoa
SYSTEMS CORPORATION

We make PCs better.

Super EGA and Super BIOS are a trademarks of Genoa Systems Corporation.
Lotus and Symphony are trademarks of Lotus Development Corporation.
© 1986 Genoa Systems Corporation
FCC Approved.

Version 1.2 Changes

Version 1.2 of Kickstart and Workbench corrects a number of bugs present in version 1.1 and adds improvements to existing features. There are also a number of new AmigaDOS commands. These are covered briefly in the appropriate sections.

Workbench

An Expansion drawer holds drivers and code required to configure and communicate to boards on the Amiga bus. For example, libraries for interfacing to the A2088 board reside in this drawer. This drawer is searched for drivers and initialization code at boot-up.

The tool SetMap allows you to select several different keyboard types, such as German, French, or Spanish.

NTSC and PAL video displays are supported.

Two utility programs for manipulating MS-DOS disks are provided. One program formats disks to the MS-DOS standard, another allows copying data to or from MS-DOS disks.

AmigaDOS

Some new commands:

addbuffers — adds sector cache buffers in memory for a drive, improving disk access time.

binddrivers — binds device drivers in the Expansion drawer to peripheral boards configured on the Amiga bus.

changetaskpri and settaskpri — allows you to change or set the running priority of a CLI task.

mount — mounts a new device. The device's characteristics and unit number are stored in the text file MountList in the devs directory.

path — allows you to specify a search path for AmigaDOS to use when searching for a program.

ROM Kernel

The 68881 math coprocessor is now supported under multitasking. Several new graphics functions have been added: DrawCircle, DrawEllipse, AreaCircle, and AreaEllipse.

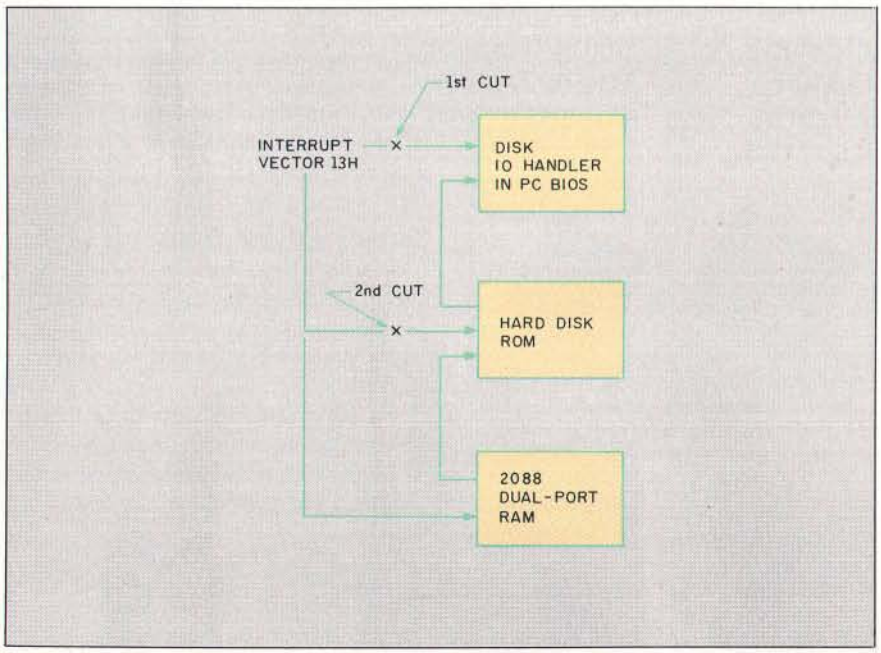


Figure 6: *Modification of the disk controller interrupt vector to support a hard disk drive. This sequence of modifications allows you to use any type of PC hard disk with the A2088 board.*

wild and perhaps doing some damage. Meanwhile, the Amiga side goes through the boot process (including AutoConfig); it executes the start-up sequence, executes a BINDDRIVERS command that loads hardware device drivers into memory and loads the A2088 Library routines. When all this loading is completed, the Amiga releases the 8088 from its RESET condition and enters a loop to await a signal from the 8088.

Released from RESET, the A2088 board's 8088 now begins executing a BIOS power-up routine. This code is, for the most part, standard and includes routines that check the 8088, perform a ROM checksum, initialize DMA channels, set up interrupt vectors, and more. However, Commodore has modified the routines so that when the A2088 has begun memory refresh, it signals the Amiga and then enters a loop to await a "go-ahead."

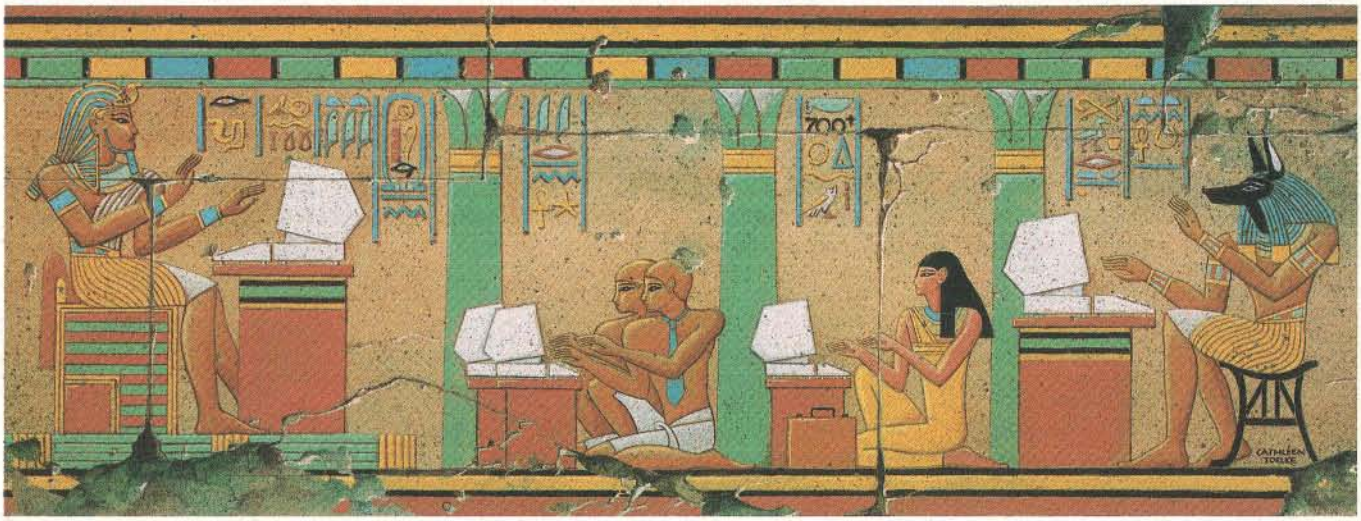
Once the Amiga has been informed that memory refresh has begun on the PC side, it reads a block of code (called PC.BOOT) from its own disk and loads it into the parameter area of the dual-port RAM (note that this is 8088-executable code). This is the only code that exists in the dual-port RAM, and it is loaded so that it appears to the PC in an address range above the region in which a peripheral board's ROM would appear. The Amiga gives the 8088 the "go-ahead" signal.

Now the A2088 completes the BIOS power-up sequence. As part of this sequence, the 8088 checks for peripheral board ROMs in the address region C8000 to F4000 hexadecimal by scanning that area in 2K-byte increments for a series of 3 signature bytes (hexadecimal 55AA followed by a length-indicator byte). If such a sequence is found, the BIOS transfers control to the address location following the signature bytes, which it assumes to be initialization code for the attached device. In this example, the device is a hard disk controller, and the initialization code takes this opportunity to reroute the INT 13H vector (see figure 6). This vector has been set by the power-up routines to point to the BIOS code that handles floppy disk I/O; the hard disk ROM alters the vector to point to its own routines. In this way, a request for hard disk I/O is intercepted by the ROM; floppy disk I/O requests are identified and passed onto the BIOS handler. The hard disk ROM initialization routine then exits and BIOS continues the scan for peripheral board ROMs.

As the BIOS power-up routine continues searching for peripheral ROMs, it encounters the PC.BOOT code in the dual-port RAM. This code is preceded by the necessary signature bytes so that it

continued

InfoMaster® service civilizes electronic information.



So anyone can use it.

Until now, electronic information services were a lot like hieroglyphics. Only a privileged few could make head or tail of them.

Now there is InfoMaster service—the extraordinary database system from Western Union that civilizes electronic information. Finally, it has become a practical, easy-to-use, business-building tool.

See alternatives from a wider perspective. Feel really prepared.

Whatever business you're in, InfoMaster makes critical information immediately accessible. Timely, comprehensive information. About your business. Your market. Your prospects. Your competition.

With InfoMaster, you spend less time looking for information...have more time to think about it. This can make a big difference in your reports, presentations, recommendations, decisions. Not to mention your career.

Not just the world's richest source of information. The easiest to use, too!

InfoMaster puts the world's leading on-line services—BRS, Dialog, NewsNet, TRW, Vu/Text and more—at your fingertips. Over 700 databases. All through a single source.

Quite civilly, InfoMaster eliminates the obstacles that prevented you from taking advantage of electronic information in the past. Imagine...there's no computerese, no commands to learn, no training needed. InfoMaster works using simple phrases.

You don't even have to know which database to choose. InfoMaster acts as your guide...leading you there, one easy step at a time. There's even free on-line assistance from a specialist, 24 hours a day. So you're never alone.

One more thing. You can use InfoMaster with any PC or terminal. No advanced communications software is needed.

Discover civilization for yourself! Sample InfoMaster right now—FREE!

There's no faster, better way to see how InfoMaster can work for you than by experiencing it for yourself right now—FREE. So phone or mail in the coupon today.

Call now for your Complimentary Password. Then get on-line and experience InfoMaster FREE.*

1-800-247-1373

Dept. 501

InfoMaster®

western union

Request your Complimentary Password by phone or mail. Sample InfoMaster—FREE.

☐ YES! I want to sample the world's largest electronic information source—FREE. Please provide me with a complimentary password so I can log-on to InfoMaster without charge or obligation.

☐ I just want more information at this time. Please send me a FREE InfoMaster Kit.

NAME _____ TITLE _____

COMPANY _____

ADDRESS _____

CITY, STATE, ZIP _____

( ) TELEPHONE _____

Mail to: InfoMaster, Dept. 501
4230 Alpha Road, Suite 100, Dallas, TX 75244-4401

A102

***Respond now and receive a FREE full-color InfoMaster poster.**

© 1986 The Western Union Telegraph Company.

Inquiry 328

Because of the complex interaction between the PC and the Amiga, the designers had to make some compromises.

"looks like" a peripheral board ROM. BIOS dutifully passes control to what it thinks is a peripheral initialization routine but which is actually a routine in the PC.BOOT code that reroutes the INT 13H vector again. Now a disk I/O request will be intercepted first by the PC.BOOT code—the Amiga side has "wired" itself into the PC side's disk I/O routines. The BIOS completes its ROM scan and the remainder of the boot process.

From this point on, the Amiga side can make I/O requests to PC disks directly to the ROM routines on the PC hard disk controller card or onto the BIOS for floppy I/O. In this way, the Amiga side can access an AmigaDOS partition on a PC hard disk by going "beneath" whatever DOS happens to be running on the PC side. (If the Amiga side were forced to access a disk on the PC side through, say, PC-DOS, an AmigaDOS partition would be inaccessible—PC-DOS will not recognize a non–PC-DOS partition.) Additionally, the PC.BOOT code performs necessary semaphore functions that prevent simultaneous disk I/O requests from both sides of the machine. Whenever the PC side performs disk I/O, PC.BOOT intercepts the I/O request and sets a flag in the dual-port RAM that tells the Amiga side to hold off on any disk I/O requests of its own.

Limitations of the Amiga 2088 Board

With the Amiga 2088 board containing an actual IBM PC–compatible computer on its board, you can run virtually any IBM- or MS-DOS–compatible program and plug in virtually any expansion card. This approach works so well because it is not an emulation of a PC—it is a PC. Right?

No, not really. Because of the complex interaction between the PC and the Amiga, the A2000 designers had to make some compromises. Your personal preferences will determine how major they are to you. Starting with the small problems and working up:

- The video display won't support flashing characters. This attribute, done in hardware on the PC, would have to be done in software on a continuous basis and would take up a lot of the Amiga's computing power. Since flashing characters aren't widely used, the A2000 designers left them out.
- The Amiga will display only monochrome PC video, 320 by 200 four-color graphics, and 640 by 200 two-color graphics. However, you can disable the Amiga-produced screen and get any kind of video you want (Hercules, EGA, PGA, or whatever) by plugging a video card into a PC slot and feeding its output to an appropriate monitor.
- IBM-compatible PCs can make only simple tones and beeps through a speaker in the body of the computer, while the Amiga can make complex sounds through a separate audio output or the sound channel of a television. Because the Amiga 2000 is multitasking, its designers could find no good way to integrate the PC audio into the Amiga's sound channels. Commodore reports that the A2088's and Amiga's sound signals can be mixed and routed to the Amiga monitor's speaker.
- While a PC program is in use, the Amiga mouse and cursor belong to the Amiga, not to the PC, so PC applications that use a mouse won't work. Commodore plans to implement this feature eventually by having the mouse emulate a Microsoft mouse.
- The PC can be given control of the Amiga's parallel port by running a program called LPT1:. This maps the parallel port to the LPT1: printer device on the PC side and prevents the Amiga from using it at all. The PC will not be able to use the Amiga's serial port when it is first released, but Commodore says it's working on similarly enabling that connection sometime in the future.
- One of the most serious flaws of the 2088 card/Amiga duo is its inexact display of the PC's video on the Amiga's screen. Remember that as the PC writes to its video memory, the Amiga must update the PC window (on the Amiga's display) to correspond with the visual interpretation of the contents of the PC's video memory. Unfortunately, even the Amiga can't keep up with that process instantaneously and this causes some noticeable effects. For example, since the Amiga must draw the characters displayed in a text window, scrolling the entire screen often causes the display to jump several lines at a time. Also, some graphics programs that use animation work (Microsoft's Flight Simulator, for example), but others don't (ExecuVision).

The A2000 designers have done what they could to improve this situation. If you are having update problems with the PC color display, you can decrease the number of bit planes the Amiga has to draw into, thus reducing the number of colors that can be shown but also decreasing the amount of time the Amiga spends to update the screen once.

- We saw only rudimentary cut and paste functions for the transfer of text (not graphic) data between a PC window and the Amiga's Notepad. For example, you can type DIR in the Notepad, copy it into the Clipboard, and then use an EDIT menu to paste the directory command into the PC window. Conversely, you can select text in the PC window by dragging the mouse over the selected region (the copy to the Clipboard is automatic) and pasting it into the Notepad. The degree to which the transfer of data between the two machines is implemented could determine the ultimate success of the Amiga 2000.

Pricing

At the time of this writing, Commodore has set only preliminary suggested retail prices for the A2000 and related products (see the text box "A2000 Peripherals"). The A2000 with 1 megabyte of memory and one 3½-inch floppy drive is set at $1499; the A2088 IBM PC–compatible board, $499; internal 3½-inch or 5¼-inch floppy drives, $199; external 3½-inch or 5¼-inch floppy drives, $299; 2-megabyte expansion memory card, $499; composite video interface card, $99; hard disk controller supporting ST506 and SCSI hard disks, $349; standard analog RGB monitor, $349; long-persistence phosphor analog RGB monitor, $499.

The under-$1500 price for the A2000 is fairly competitive. This makes an A2000 with a high-quality RGB color monitor cost around $2000, which is slightly less than the $2199 price of an Apple Macintosh Plus (not counting the inevitable discounting more likely to be available on the older Macintosh Plus line).

Potential buyers of the A2088 board should note that the hidden cost of a 5¼-inch floppy drive brings the price of a usable IBM PC–compatible computer to between $700 and $800.

Caveats

We wrote this product preview in December 1986, after two meetings with Commodore engineers and several follow-up calls; there was very little documentation because the A2000 and the Amiga 2088 board were so recently finished. We had access to two machines for little over a week. One had an Amiga 2088 board with a 10-megabyte Hardcard shared by the Amiga and the PC, an IBM multifunction board, and 512K bytes of memory; the other had a 5¼-inch, 20-megabyte hard disk connected through the SCSI port of the Amiga 2094 Hard Disk/SCSI controller board and an Amiga 2050 2-megabyte memory board. Both had 512K bytes

A2000 Peripherals

Commodore will release the following peripheral boards with the Amiga 2000.

Hard Disk Controller

The 2094 Hard Disk/SCSI (HD/SCSI) controller board is a full-size Amiga card that plugs into one of the Amiga bus slots and allows access to the two most popular hard disk interfaces: ST-506 and SCSI (small computer system interface). To date, most hard disks available for microcomputers are equipped to connect via the ST-506 standard interface. However, more and more SCSI-compatible hard disks are emerging, and indications are that this interface will ultimately replace the ST-506 standard due to SCSI's faster transfer rate and flexibility. The HD/SCSI board can control up to two ST-506–compatible drives and up to seven SCSI drives in any combination.

The ST-506 portion of the board is built around a custom LSI chip called the DJC (manufactured by the Konan Corporation) that performs most of the control functions (data serialization, error correction, etc.). The data-transfer rate on the ST-506 side of the board is on the order of 5 megabits per second. On the SCSI side, the HD/SCSI board uses a Western Digital 33C93 SCSI controller chip. This chip incorporates some intelligence, so that SCSI commands can be issued quickly and succinctly. Up to 128K bytes at a time can be read to or written from a hard disk. The board's data-transfer rate on the SCSI side is around 10 megabits per second.

An on-board Z80A processor running at 4 MHz can operate both the ST-506 and SCSI sides of the board. (The Amiga's 68000 can issue commands directly to the 33C93 chip. When we saw the board running an SCSI drive, it was with the 68000 managing the SCSI channel.) The Z80 is provided with a 2K by 8 on-board RAM into which the 68000 can download commands so that the Z80 can perform a series of hard disk functions in a true coprocessing fashion. Throughput is further enhanced by a proprietary DMA controller chip with a built-in 64-byte FIFO memory. Using this chip, you can transfer data from disk to memory at full speed (depending on which interface your disk is connected to) while consuming only 16 percent of the Amiga bus's time. This suggests some interesting possibilities, since you could download an entire screen's data from a hard disk directly to video memory at the rate of approximately 800 ns per byte.

The HD/SCSI board provides not only an SCSI 50-pin connector, but also a Macintosh Plus–compatible DB-25 connector. This addition is good planning; you can immediately draw from the growing number of Mac Plus SCSI drives that appear to be getting less expensive by the week.

Memory Boards

Commodore will release three memory boards with the A2000. The boards fall into two general classes: One plugs into the 86-pin CPU slot and two plug into Amiga bus slots. The former will be shipped with early versions of the A2000 and will be populated with 512K bytes, bringing the total memory of the machine as shipped to 1 megabyte. (Commodore intends to ultimately provide 1 megabyte directly on the A2000 motherboard, so that later A2000s will not come with this board installed. Since the stated purpose of the 86-pin CPU slot is to allow for the installation of an alternate CPU—a 68020, perhaps—purchasers of early A2000s may find themselves unable to make use of any future coprocessor boards unless they give up some memory.)

The other two memory boards plug into an Amiga bus slot. One board can be populated with up to 2 megabytes of RAM in increments of 512K bytes, 1 megabyte, or 2 megabytes; the other can accept up to 8 megabytes (Commodore had not yet determined what partial amounts the board could be configured to accept). These boards are based on the same design; the engineer who had developed them told us that once he had built a working version of the 2-megabyte board, it took him only a matter of weeks to produce an 8-megabyte board. Both boards perform memory refresh during cycles when the processor is off the bus, so that memory refresh is invisible.

You may be asking yourself what advantage the 2-megabyte board has over the 8-megabyte board, particularly if the latter is available in partially populated form. The advantage is simply cost: The 2-megabyte card is a single-layer circuit board, while the 8-megabyte card is a double-layer circuit board. Additionally, the 2-megabyte board can accept the less expensive 256K-bit DRAM chips as well as 1-megabit DRAM chips; the 8-megabyte board can only accept 1-megabit DRAM chips.

All three memory boards sit on the fast RAM side of the A2000 where there is no contention between the 68000 and the graphics processors. The 2-megabyte and 8-megabyte boards support the AutoConfig feature and, although the 1-megabyte board does not, the system is able to recognize its presence. None of the memory boards support write protection, an extremely desirable feature if you plan to use the memory for a RAM disk. (We mentioned this to the boards' designer; he told us that he thought he could add write protection to the 8-megabyte board by reprogramming a PAL, and that he would consider adding the capability.)

of memory on the motherboard but lacked the extra 512K that will ship in the CPU slot of the A2000. The computers, according to Commodore, were off the "first production run" and had no wires on any of the circuit boards. The Amiga 2088 board ran MS-DOS 2.11, but Commodore said the board would ship with MS-DOS 3.2. The A2088 board didn't have an 8087 coprocessor installed, so we cannot comment on its performance. The Amiga software was pretty stable but might still undergo some small changes.

Observations

The computer we looked at was still unfinished, so this product preview is not the place for us to run benchmark programs and, in general, critique its strengths and weaknesses. Still, we feel the comments below are in order, largely because the units we saw were much more "stable" than most of the other computers we preview.

Overall, the A2000 with the optional A2088 card delivers a second-computer-in-a-box better than most of the previous attempts to do so in this industry. Stan Wszola, a BYTE editor who regularly uses

continued

Though the interaction between the Amiga and the PC is minimal, there are opportunities for someone to write a hybrid program.

an IBM PC compatible, said the A2000 ran and looked like a normal PC. We ran one benchmark, the Sieve of Eratosthenes, and found that the Amiga ran it within one second of the time recorded for a "plain vanilla" IBM PC.

One fascinating implication of using the Amiga to display the PC monochrome and video screens is that the colors used in the screen can be chosen from the Amiga's palette of 4096 colors. This makes working with PC software—especially programs that use graphics—a lot easier on the eye. When a PC screen is in an Amiga window, you can scroll both vertically and horizontally to see any portion of it (see photo 6). Alternately, you can double-click on the window and get a full 25-line by 80-character display with no window border. If you set your colors right, you don't even know you're on an Amiga! On the other hand, the system with the A2088 board installed takes between 1½ and 2 minutes to boot even if you aren't going to use the PC capabilities.

Though the normal interaction between the Amiga and the PC is minimal, there are some real opportunities for someone to write a hybrid program that uses both the 8088 in the PC (perhaps augmented by an 8087 numeric coprocessor) and the 68000 in the Amiga to achieve performance that is beyond either of the two machines alone.

Amiga's use of Kickstart 1.2 in ROM speeds up the A2000's loading, but it presents problems to some prospective customers. There is no way the A2000 can load Kickstart 1.1 into memory, and we found several programs that wouldn't run correctly in the A2000. In general, games were less likely to run than "serious" applications, and (this comes as no surprise) older programs were less likely to run than ones released more recently. This is a problem that should eventually go away as more new products come out using Kickstart 1.2 and older ones are (perhaps) upgraded.

Clive Smith, general manager of the Commodore Product and Market Development Group, indicated that the 2088 was just the beginning of the A2000's extension into coprocessing. "Commodore has provided for integrating 80286 processors and coprocessors into the Amiga environment," Mr. Smith said. "Commodore is currently developing its own A2286 card and support software, which will bring [IBM PC] AT-level coprocessing to the Amiga environment. The next multiprocessor/multiDOS environment which Commodore is implementing for the A2000 is a 68020-based version of UNIX 5.2 [UNIX System V, version 2] that uses a proprietary MMU [memory management unit] currently under development and evaluation, which will be manufactured by the company's MOS Technology division."



Photo 6: *Running IBM PC software on the A2000. Here, the Amiga's desktop screen has been "pulled down" to reveal the PC color display screen. You can see Microsoft's Flight Simulator program running in the PC screen.*

Conclusions

Who will buy this machine? Certainly people who want an 8-megabyte Amiga with one or more hard disks will. Although the original Amiga, the A1000, can be expanded, that task was taken on by small companies that work in low volumes and so must charge higher-than-average (when compared with the IBM or Macintosh worlds) prices. Commodore never produced a card cage for the A1000 and will eventually discontinue the machine (no specific date has been set, though, and Commodore pledges to continue supporting the A1000).

The A2000's expandability and its IBM PC compatibility make the computer a valid possibility for business and scientific users. The ability to expand the machine's memory and disk storage within a reasonably sized box is an unobtrusive but important change from the A1000. Some users will be attracted to the multiprocessing of a machine that can run 8088 and 68000 software in parallel, with the possibility of the same computer someday running, say, an Intel 80286 processor with a Motorola 68020 processor and assorted numeric coprocessors on both sides.

Professionals (especially scientists, engineers, and artists) who are already attracted to the Amiga's graphics or other features will now be able to buy a machine with the memory and disk storage they need. Other users who are attracted by the Amiga but who work in offices that use IBM PCs can now "safely" buy an office computer that has both Amiga and IBM capabilities. These same people may now be interested in buying an Amiga for home use, knowing that they can also use it to do PC-related work brought home from the office.

Software for the Amiga family of computers has grown to quite a respectable level in the year and a half since the A1000's release. Now that Commodore has introduced a machine that has elbow room inside it for more system resources and for entirely new hardware products, we can expect similar growth in Amiga hardware in the year to come. This development can only help the fortune of this most capable and exciting line of microcomputers. ■

Introducing PC performance at a terminal price.



The versatile PC Station.™ From TeleVideo.®

With all the power an AT offers, it's no wonder more people are using it to drive multi-user systems.

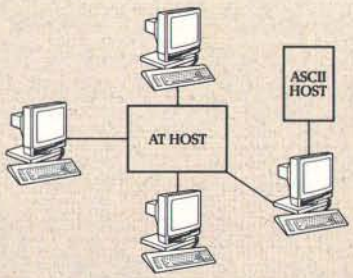
And when it comes to using all this power, only one workstation gives you so many features for so little money: the TeleVideo PC Station.



As you can see, the back panel of the PC Station is exactly the same as the IBM PC's, with fully IBM-compatible ports for hooking up industry-standard peripherals.

This ASCII terminal has the precise look and feel of a PC. But that's just the beginning. It also has a back panel that's identical to the IBM PC's, with a parallel printer port. A serial port. And two host ports, so it can be simultaneously connected to an ASCII mainframe host and an AT host. There's no loss of memory when changing hosts, because the PC Station holds a page of memory from each at the same time.

And the PC Station gives you even more. Like a 132-column display, for spreadsheets. Programmable function keys, for customization. For better readability, there's a green, non-glare 14" screen, with IBM-style character fonts. Plus a smooth, quiet AT-style keyboard, with keytop LEDs. All included in the low $629 list price.



The PC Station is the only terminal of its kind with dual-host capability, which allows it to be connected to a mainframe host and an AT host simultaneously.

The TeleVideo PC Station. For a free solutions guide, and the name of your nearest TeleVideo dealer, call 1-800-835-3228, Dept. 271.

And check out the workstation that offers you all the benefits of a PC–without a PC price.

TeleVideo®
Settle for more.

TeleVideo Systems, Inc., 1170 Morse Avenue, P.O. Box 3568, Sunnyvale, CA 94088-3568 • (408) 745-7760

IBM and AT are trademarks of International Business Machines, Inc. ©1986 TeleVideo Systems, Inc.

Why RamFont™ is so essential to your software.

Until now, most programs could only display 256 pre-programmed characters.

Just enough for the regular alphabet, some numbers and a few special symbols.

Enter the Hercules™ Graphics Card Plus.

Its extraordinary new RamFont mode can store up to 3072 *programmable* characters, and display them at lightning-fast speed.



And RamFont is so flexible, you can even mix graphics on the same screen as text.

A whole new generation of software is available now, taking advantage of RamFont's unique capabilities to give you more power and speed than ever before.

Lotus® 1-2-3.®

By using RamFont to display smaller-than-standard characters, 1-2-3 Release 2 gives you a spreadsheet that shows almost twice as much data as before.

And, RamFont makes scrolling instantaneous and smooth, rather than painfully slow and jerky.

You can even view a graph in a pop-up window—another RamFont first.

Microsoft® Word 3.

Word 3 was the first PC word processor that let you see boldface, italics, subscripts and superscripts mixed with regular text.

But it was slow.

Not anymore.

With RamFont, Word 3 runs almost four times faster.

Lotus Manuscript.™

Manuscript is Lotus' new technical word processor, written to run optimally on the Hercules Graphics Card Plus.

It uses the RamFont mode for fast, multiple-font text editing.

Then it switches to graphics mode to format a page for printing, showing proportionally spaced equations.

Even more goodies.

Besides these dramatic improvements, RamFont also dramatically improves the scrolling speeds of Symphony® 1.1 and Framework II.™

For WordStar,® there's a RamFont add-on that lets you use multiple fonts.

There's even a new word processor that lets you write in Greek, Russian and Hebrew, *on the same screen.*

And there's more incredible RamFont software right around the corner.

And now, the *really* good part.

RamFont is only one of the Hercules Graphics Card Plus' major advantages.

You also get our famous high resolution graphics, to run programs like AutoCAD® and Pagemaker.™

And our high resolution text mode that runs thousands more programs.

And a parallel printer port that can be "unplugged" for greater flexibility.

Here are a few of the programs taking advantage of RamFont.

Lotus 1-2-3 Release 2 (and later)
Lotus Symphony Version 1.1
Lotus Manuscript
Microsoft Word 3.1 includes mouse support
Ashton-Tate Framework II
Nota Bene™
PS™
Computer Linguist

For a complete list, contact Hercules.

All for the astonishingly low suggested list price of $299.

Which, on top of the Plus' performance, has caused a few people in the industry to get unusually excited:

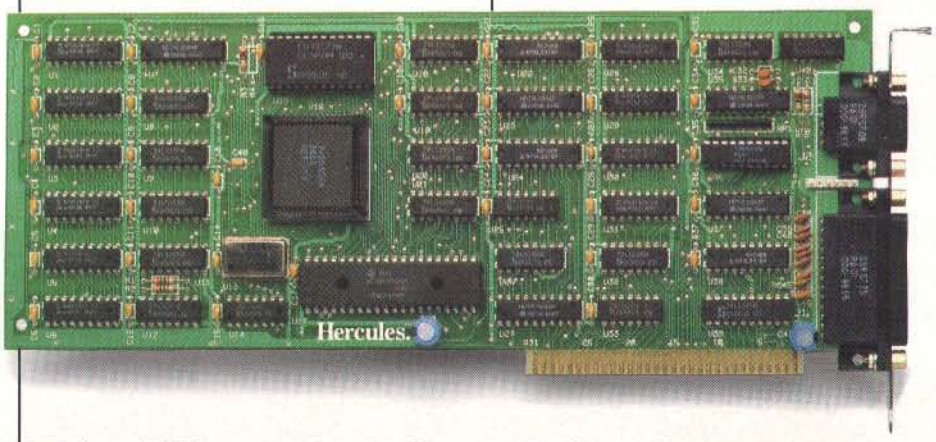
$299
Suggested Retail Price.

"If you intend to buy an IBM PC or clone and want to run a monochrome system, this is the card to get. I wouldn't even think of anything else."

John C. Dvorak,
PC Magazine *columnist.*

Neither would we.

Call 1-800-532-0600 ext. 212 for the name of an Authorized Hercules Dealer near you and we'll rush you our free info kit.



The Hercules Graphics Card Plus with RamFont.

Address: Hercules, 2550 Ninth Street, Berkeley, CA 94710. Ph: 415 540-6000. Telex: 754063. **Trademarks/Owners:** Hercules, RamFont/Hercules; Lotus, 1-2-3, Manuscript, Symphony/Lotus; Microsoft/Microsoft; Framework/Ashton-Tate; WordStar/MicroPro; AutoCAD/AutoCAD; Pagemaker/Aldus; Note Bene/Dragonfly; PS/Scroll Systems.

Inquiry 131 for End-Users. Inquiry 132 for DEALERS ONLY.

George A. Stewart

Turbo BASIC

Borland's version offers 8087 compatibility, fast and versatile compilation, recursion, and it's BASICA-compatible

Turbo BASIC is Borland International's answer to Microsoft BASIC. With minor exceptions the integrated editor, compiler, and linker can use source code written for the QuickBASIC 2.0 compiler and the BASICA and GW-BASIC interpreters. The language also offers certain structured programming constructs not available in any version of Microsoft BASIC. But these aren't the features that could upstage Microsoft.

Most important, Turbo BASIC implements the IEEE standard for numeric data storage and operations. As a result, Turbo BASIC programs are able to use the Intel 8087 (or 80x87 family) numeric coprocessor when that chip is installed in the host computer, gaining a tremendous speed advantage in number-crunching applications. (When no 8087 is available, the program automatically emulates an 8087 via software.) Meanwhile, Microsoft continues to use its nonstandard system for numeric data, thwarting compatibility with the 8087 and limiting the arithmetic precision and range available in Microsoft BASIC.

Turbo BASIC has other features that will probably be welcomed by software developers. Conditional compilation, for instance, lets a single source program produce different executable versions depending on the state of compiler variables; the static arrays in an accounting package might be configured differently, say, for use in California and Arizona.

Like Turbo Pascal, which put Borland on the map with Pascal programmers, Turbo BASIC creates stand-alone programs that require no run-time library or other support files. A programmer can sell these .EXE programs without paying any royalties or licensing fees to Borland. The announced price of Turbo BASIC is just $99.95—again mimicking the low-cost appeal of Turbo Pascal.

As of mid-January, Borland expected to begin shipping the IBM PC–compatible version of Turbo BASIC in the first quarter of 1987. (No other versions have been announced to date.) This article is based on a preliminary version of the product.

User Interface

Turbo BASIC is a combined program editor, compiler, and run-time system. The functions are integrated via a windowing system with pull-down menus used to select different operations (see photos 1 and 2). Unlike QuickBASIC, Turbo BASIC does not include support for the mouse as a cursor-control device.

At the command level of Turbo BASIC, four windows are defined: "Edit" lets you edit a BASIC source program. "Run" is the output window for text and graphics created by your program. "Message" presents system-generated information about the compilation progress and the size of your compiled program. "Trace" (when enabled) displays the line number or label of the statement or procedure currently being executed. At any given time, only one of the windows is active; the active window can be moved, resized, and closed. Any window can also be zoomed to full-screen size by pressing the F5 function key.

Pressing F1 calls up a context-sensitive help screen; however, this feature was not implemented in the prerelease version I tested.

The top line of the display lists eight menus: Files, Edit, Run, Compile, Options, Debug, Window, and Setup.

The Files menu includes options for loading and saving a source file to and from disk, starting a new source file, exiting from Turbo BASIC, and so on. Turbo BASIC's windowing system is particularly handy when you want to load or save a file or change directories; Turbo BASIC presents a directory window in which you can move the cursor around to specify the desired file or path. Subdirectories and root directories are also shown in these windows, enabling you to move throughout the entire directory structure of a disk. File selection in QuickBASIC 2.0 is similar.

The Files menu also lists a "shell" option to let you transfer control to DOS, enter commands there, and return to Turbo BASIC manually by typing the DOS command EXIT. QuickBASIC 2.0 also supports a shell feature.

The Edit, Run, Compile, and Debug menus perform the indicated operations on the currently loaded source file. I will discuss these in detail later on.

The Options menu controls the operation of the compiler in several ways. For instance, the "Compile to" setting determines whether the compiler outputs its code to memory (the usual case during program development), to an .EXE file (to create a stand-alone application), or to a "chain" file that can be executed only via a CHAIN command in an .EXE file. The chain file capability allows you to have applications that are larger than a computer's available memory; only portions of a program are resident at any given time.

Other check-off items on the Options menu are support for the 8087; the ability to stop a program with Ctrl-Break; and run-time checking of array references, numeric overflow, and stack overflow. The 8087 setting determines whether the com-

continued

George A. Stewart is a BYTE technical editor. He can be reached at BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

Turbo BASIC incorporates the needed run-time routines into your executable file automatically.

piler generates in-line 8087 code unconditionally or generates self-modifying code that will access the 8087 or emulate it depending on whether the run-time host has the coprocessor installed.

Turbo BASIC provides a COMMAND$ function that retrieves parameters from the command string used to invoke a program. The Options menu enables you to test how well a program uses this feature without having to execute the program from the DOS command line. A "Parameter line" option lets you specify the text that would normally be typed on the command line. When you run a program that uses COMMAND$, the specified text will be returned.

The Options menu also gives you control over the size of the run-time stack, music buffer, sound buffer, and communications buffers (COM1 and COM2).

The Window menu lets you open and close windows, switch between them, and arrange them automatically in one of two ways: tiled or stacked.

The Setup menu lets you customize features of the Turbo BASIC user interface. You can control the appearance of text within pull-down menus, windows, and system boxes; control how selected text in any of these is highlighted; and specify a default path to be used for $INCLUDE files (explained below), .EXE files, and Turbo BASIC files. Other Setup options let you select a "CGA snow check" to improve performance on color screens driven by the IBM color graphics adapter, and specify automatic saves of edited source files before they are run.

The Setup menu also lets you load a previously defined configuration file or save the current configuration so it can be loaded automatically or manually each time you start Turbo BASIC.

Overall, Turbo BASIC's user interface is easy to master and quite versatile.

Edit/Compile/Run/Debug Sequence

The typical procedure for running a program in Turbo BASIC is as follows. Load a source program using the Files menu or type a new one into the Edit window. Type C to compile the program. The Compile window shows the status of the compilation and, when compilation is complete, gives the size and segmentation of the executable program in terms of code, data, and stack areas. You now press R to run the program. If you type R without first compiling the program, Turbo BASIC compiles and runs it in a single step. You will probably want to zoom the run window to full screen while your program is running.

Veterans of Microsoft's original BASIC compiler, BASCOM, and users of QuickBASIC may be looking at this point for some reference to the linking of .OBJ files. Turbo BASIC doesn't use .OBJ files. Instead of producing relocatable object modules that the user links manually to produce an executable file, Turbo BASIC goes directly to the executable code.

In QuickBASIC, the link step can be performed automatically if you specify it, but the resulting .EXE file is not stand-alone. It will run only in the presence of Microsoft's run-time package BRUN 20.EXE. To get a true stand-alone program from QuickBASIC, you must do the compile and link steps familiar to BASCOM users.

The advantage of the Turbo BASIC approach is simplicity. There is never any need to link a main program to a run-time library because Turbo BASIC incorporates the needed run-time routines into the .EXE file automatically. The apparent disadvantage is that commonly used sections of code must be compiled with each source program that references them. In a system with separately compiled object modules, these library routines can be compiled one time and then linked to the various main programs that refer to them.

However, Borland programmers maintain that Turbo BASIC will process source code so much faster than older-generation BASIC compilers—thousands of lines per minute as opposed to hundreds—that the time penalty for recompiling these oft-used routines is negligible. In fact, Borland predicts that version 1 of Turbo BASIC will turn source code into executable code much faster than QuickBASIC can compile and link the same source code to produce an executable program. This contention was borne out in our tests of the prerelease version of Turbo BASIC. Turbo BASIC's compile-to-.EXE file time was one-fourth the time QuickBASIC took to compile and link the same file. (See the performance chart on pages 104–105 for our test results.)

Another possible objection to Turbo BASIC's inclusion of run times in every .EXE file concerns disk space. When several applications can share the same run-time library, each application can be smaller. But when each application includes its own run-time library, a lot of identical code gets duplicated.

Borland programmers respond that most commercial applications are distributed alone on a disk, making moot the question of run-time library duplication. And for applications too large to fit in memory at once, Turbo BASIC allows the creation of chain programs that do not include run-time libraries; instead, when a main program passes control to the chain program, the run-time library of the main program stays resident. (Creating a chain file is one of the compiler options on the Options menu.)

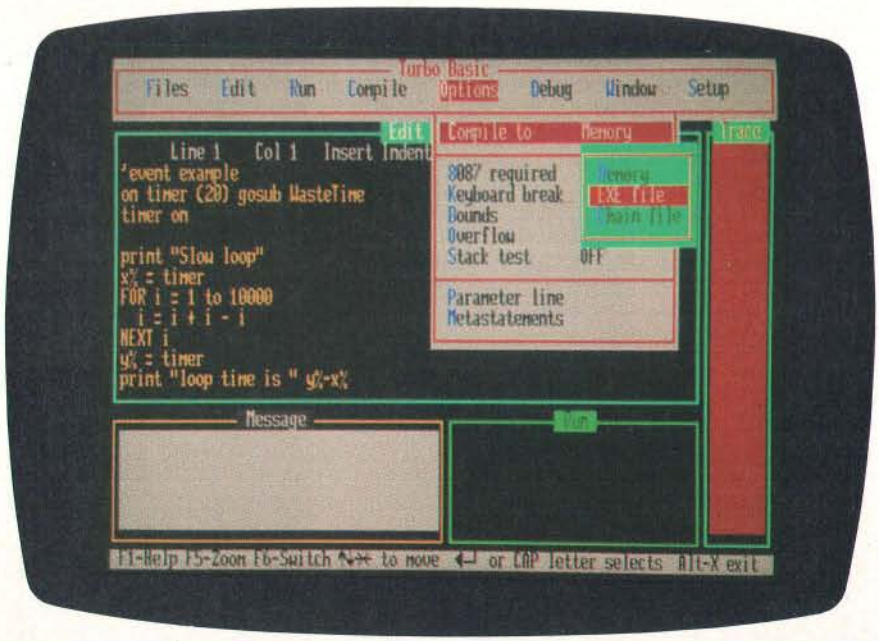


Photo 1: *Turbo BASIC screen showing pull-down menus and the four windows.*

Advanced programmers who work with many languages may have another objection to the absence of support for separately compiled relocatable object modules. Not having a way to link separately compiled object files limits your ability to use relocatable code from other sources such as assemblers and other languages. With Microsoft BASIC, you can incorporate an assembly-language object module into a program through linking—providing, of course, that you handle parameter passing and other interfacing matters properly. To accomplish the same thing in Turbo BASIC, the assembler code must be in opcode form and be fully relocatable. Under that condition, you can incorporate it into your program via the $INLINE compiler directive. QuickBASIC's method of linking to an assembler (or Pascal, FORTRAN, etc.) object module is more versatile though sometimes less convenient.

Debugging

If an error is detected during compilation, the Edit window is activated and the cursor is positioned at the point of the error. (QuickBASIC continues the compilation, remembering up to 25 errors.) If an error occurs while the program is running, Turbo BASIC activates the Edit window and points out the error location and error type. Of course, this is possible only while you are using the Turbo BASIC environment. If an error occurs while you are running an .EXE program, all you will get is the error number and the program counter value. To use this information, you start Turbo BASIC, load the main program, select a Debug option called "Runtime error," and enter the program counter value. The compiler will then recompile your source code, stopping when it reaches the point in the source code corresponding to the program counter value. It's an ingenious answer to one of the traditional disadvantages of compilers as compared to interpreters—debugging is slow and tedious.

Another Debug option is the Trace function, familiar to Microsoft BASIC users. When activated, the function displays in the Trace window the source program line numbers and labels (including functions and procedures). In Trace mode, Turbo BASIC lets you single-step a program or execute lines continuously as they are encountered. QuickBASIC's debugging environment offers Trace and an animated mode for monitoring program execution closely.

The Editor

Turbo BASIC's editor is very similar to the one used in Turbo Pascal and closely resembles the WordStar word processor. It is screen-oriented rather than line-oriented and has many more features than the typical program editor.

Single-key sequences give you cursor motion by character, word, line, and screen page, as well as delete character, word, and line, and insert line. Two-key sequences give you top of file, bottom of file, top of window, bottom of window, page up, page down, and start of block, end of block. Other block commands are mark block beginning and end, mark word, copy block, delete block, read block from disk, write block to disk, and hide or display block. Other key sequences allow global search and replace, search for the *n*th occurrence, set and find place marker, save to disk and exit, and exit without saving text to disk. Turbo BASIC's editor allows you to embed control characters in a program (typically and advisedly inside quotes as a literal) by pressing Ctrl-P followed by the character.

Many programmers use indentation to make a program's structure obvious. Turbo BASIC's editor has an auto-indent feature to facilitate entering programs in this manner; after pressing Return, the next line is automatically indented to match the indentation of the previous one. At the end of an indented block, you backspace to delete the unwanted tabs. The feature can be turned on or off with a two-key sequence.

Word processing is an essential part of serious programming, and Turbo BASIC has an editor that is up to the task.

Handling Large Source Files

The Turbo BASIC editor is limited to 64K-byte text files. The way around this problem is to use $INCLUDE statements in your main program. Each $INCLUDE statement tells the compiler to read in the referenced source code module.

Turbo BASIC's editor is very similar to the one used in Turbo Pascal and closely resembles WordStar.

If your program generates an error during compilation or execution, Turbo BASIC will load the error-causing module and activate the Edit window with the cursor on the point of the error. $INCLUDE files can themselves contain $INCLUDE statements (up to six levels deep).

Turbo BASIC does not have an option for generating a compiler listing file. Listing files are invaluable in debugging and optimizing programs. They also enable you quickly and reliably to relate the program counter values given in an error message to the source code that generated the executable program. Compiler listings also give you an inside view of how smart a compiler is, and they bring to light techniques a compiler uses. QuickBASIC 2.0 doesn't give listings files, either.

The Language

Being BASICA-compatible largely defines the language features of Turbo BASIC.

continued

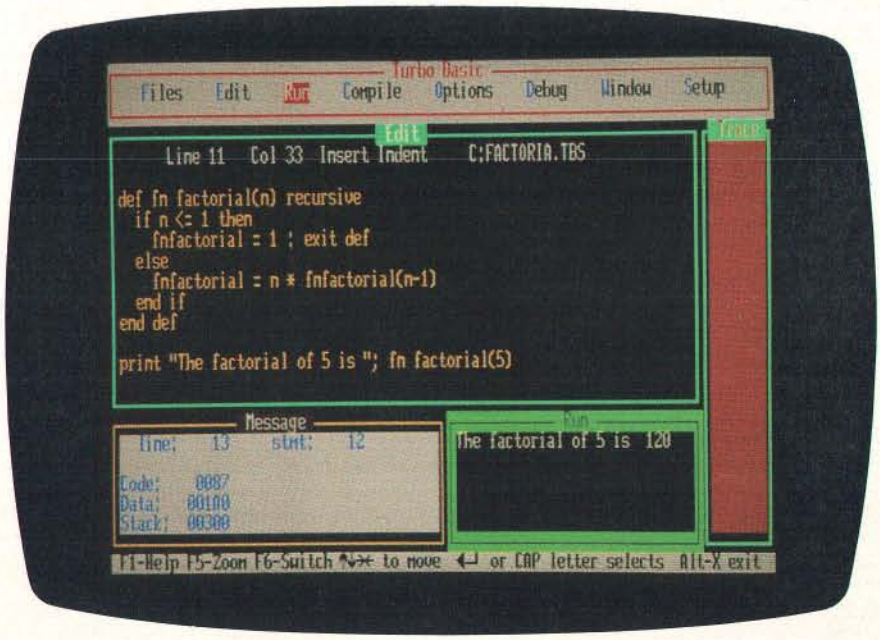


Photo 2: *Turbo BASIC screen showing a recursive factorial program.*

Turbo BASIC (Prerelease Version) vs. QuickBASIC 2.0

COMPILER PERFORMANCE (PARANOIA.BAS)

These tests were done using a 669-line source program called PARANOIA.BAS, which includes extensive arithmetic and flow-control statements, but little in the way of graphics commands. The program was created as a floating-point benchmark. For further details, see "Paranoia: A Floating-Point Benchmark" by Richard Karpinski, February 1985, page 223. All times are in seconds.

Compile and Link in Memory

Compiler	Time	Comments
Turbo BASIC 0.69f	42	8087 off, keyboard break enabled, bounds checking on, overflow checking on, stack overflow checking on.
QuickBASIC 2.0	72	Debug on, ON ERROR enabled, RESUME enabled, optimized for speed.

Compile and Link to an .EXE file

Compiler	Time	.EXE file size	Comments
Turbo BASIC 0.69f	47	96,808	8087 off, keyboard break enabled, bounds checking on, overflow checking on, stack overflow checking on.
QuickBASIC 2.0	100 (compile) + 88 (link) = 188 total	101,704	QB parameters /d/e/o/x/q (debug on, ON ERROR and RESUME enabled, create stand-alone .EXE file, optimized for speed.)

RUN-TIME PERFORMANCE

These tests were run using standard benchmark tests combined by Borland into a single program. The original source program compiled and ran without modification under Turbo BASIC 0.69f and QuickBASIC 2.0. The host compiler was an IBM PC with 512K bytes of RAM and a 4.77-MHz 8088 processor. Turbo BASIC was also benchmarked on a 4.77-MHz IBM PC with 512K bytes of RAM and an 8087 numeric coprocessor. QuickBASIC programs were compiled using /o/q options (create stand-alone .EXE files, optimize for speed, no error checking, no keyboard break checking). Turbo BASIC programs were compiled with no error checking and no keyboard break checking. All times are in seconds.

Graphics (Screen Mode 1, CGA, 320 by 200 Pixels)

Run-time program creator	Draw 500 circles	Draw 320 lines	Draw 500 boxes	320 vertical lines	200 horizontal lines	Fill 200 circles	Fill 200 boxes
Turbo BASIC 0.69f with 8087	43.0	4.9	4.5	4.5	0.3	69.6	3.2
Turbo BASIC 0.69f without 8087	44.4	7.4	7.1	6.2	1.3	71.4	4.3
QuickBASIC 2.0	53.4	5.7	5.2	4.8	0.4	93.5	3.1

Math (Add, Subtract, Divide, 10,000 Times; Multiply 20,000 Times)

Run-time program creator	Integer math	Floating-point single-precision	Floating-point double-precision	Mixed-mode floating-point	Calculate 720 sines and cosines
Turbo BASIC 0.69f with 8087	1.5	3.6	3.8	2.2	0.9
Turbo BASIC 0.69f without 8087	1.5	83.6	86.5	54.9	18.5
QuickBASIC 2.0	1.5	17.4	28.1	23.3	4.8

Loops

Run-time program creator	FOR/NEXT, floating-point counter	FOR/NEXT, integer counter	WHILE/WEND, floating-point test variable	WHILE/WEND, integer test variable
Turbo BASIC 0.69f with 8087	21.8	0.2	21.0	0.3
Turbo BASIC 0.69f without 8087	319.9	0.2	312.3	0.4
QuickBASIC 2.0	43.8	0.2	44.2	0.3

Empty Function and Procedure Calls

Run-time program creator	Integer function, no parameters	Integer function, four parameters	Floating-point function, no parameters	Floating-point function, four parameters	Procedure, no parameters	Procedure, four parameters
Turbo BASIC 0.69f with 8087	3.5	4.7	5.1	6.1	1.0	1.7
Turbo BASIC 0.69f without 8087	3.5	4.7	20.1	21.8	0.9	1.7
QuickBASIC 2.0	3.7	4.6	5.6	6.4	4.6	5.0

Savage Benchmark (Accuracy Test)

Run-time program creator	Double precision			Single precision		
	Time	Result	Error	Time	Result	Error
Turbo BASIC 0.69f with 8087	4.7	2500.000000000005	5.0×10¹12	4.6	2500.0	0.0
Turbo BASIC 0.69f without 8087	NA	NA	NA	NA	NA	NA
QuickBASIC 2.0	175.3	2499.999999941009	5.899×10¹8	47.9	2403.318	96.682

This test calculates the value of TAN(ATN(EXP(LOG(SQR(A*A))))) for A=1 to 2500. The value 1 is added to each result, which at the end should equal 2500 exactly. (Note that single-precision results for Turbo BASIC are accurate only within the limitations of single precision; the inaccurate digits are to the right of the least significant single-precision digit, and thus are not shown.) The program would not run under Turbo BASIC 0.69f without a numeric coprocessor available.

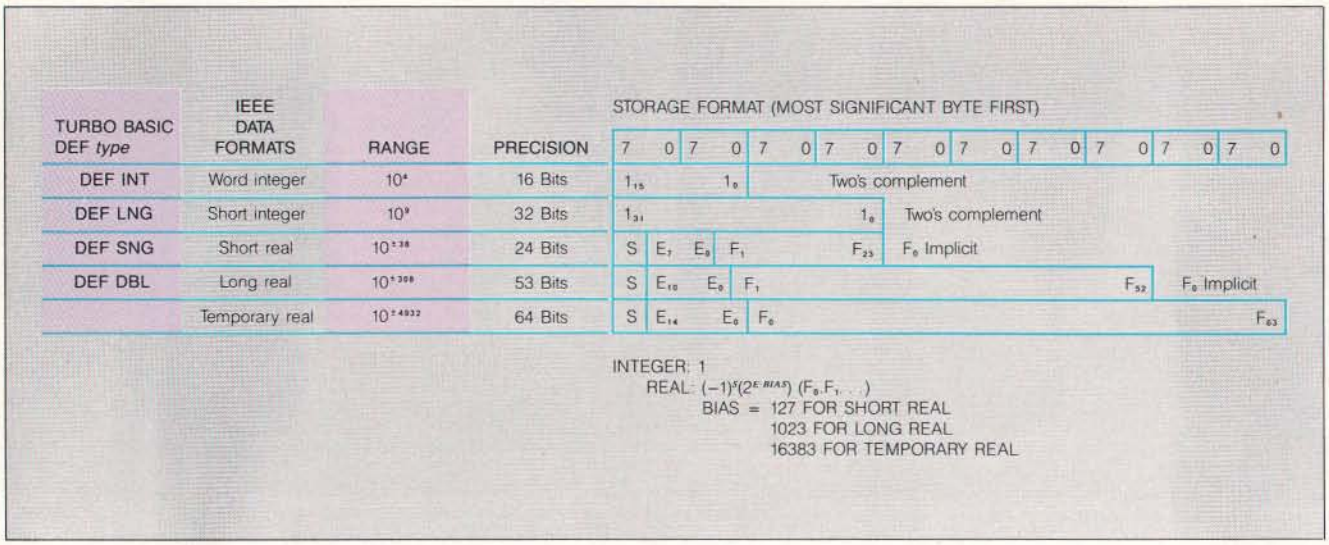


Figure 1: *IEEE numeric data types supported by Turbo BASIC.*

However, Turbo BASIC includes several important enhancements and additions to BASICA.

The most important difference concerns number-crunching capabilities. Turbo BASIC numeric data types correspond to those defined in the proposed IEEE microprocessor floating-point and extended precision integer data types and implemented in the Intel 80x87 numeric coprocessor.

Using the terminology of the Intel 80x87 documentation, Turbo BASIC supports word integers (two bytes, 16-bit precision), short integers (four bytes, 32-bit precision), short reals (four bytes, 24-bit precision), and long reals (eight bytes, 53-bit precision). Furthermore, all temporary floating-point values are stored as temporary reals (10 bytes, 64-bit precision) as required in the IEEE standard. Figure 1 defines these types more specifically.

In Turbo BASIC terminology, these numeric data types are called integer, long integer, single precision, and double precision. Except for long integer, the names are familiar and preserve compatibility with Microsoft BASIC. But the internal differences are very important, since they make Turbo BASIC numeric data fully compatible with the requirements of the Intel numeric coprocessor 80x87 chip family, so that floating-point operations can be offloaded onto the 8087 without requiring a time-consuming data conversion.

Contrast this with Microsoft BASIC's three traditional numeric data types: integer (16 bits, the same as Turbo BASIC's); single-precision (24 bits, approximately the same as Turbo BASIC's); and double-precision (8 bytes). For internal, temporary values, Microsoft uses the double-precision data type. To use the numeric coprocessor where it matters most—for double-precision operations—every Microsoft value would have to be converted to the long-real format and the result converted back again to Microsoft double-precision. This latter step could present problems, since the range of long reals is many orders of magnitude greater than Microsoft's double-precision ($\pm 10^{\pm 308}$ as opposed to $\pm 10^{\pm 38}$.

Of course, you pay a price for the added

continued

DataSaver® Standby UPS

90 Watt. The original micro-UPS that brought standby AC power to Apple users in 1980. Still the POWER SOLUTION for serious applications of the MAC, small micros, and portables.
Model 9012060 $350. FCC(15A&B).

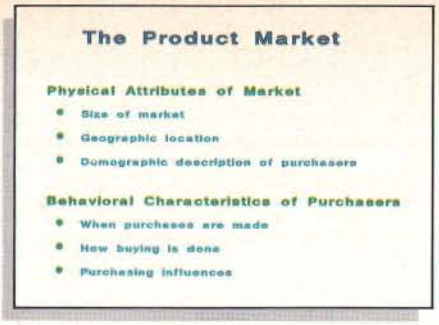
400 Watt. Now, POWER PROTECTION and MASTER CONTROL for full-size micros. Filters electrical noise/spikes and provides up to 10 minutes of AC power for the AT and supermicros
Model 40012060 $695. UL-E101268.

200 Watt. This DataSaver standby UPS offers compact, cool and quiet line conditioning and backup power to PC, XT, and COMPAQ markets. Data and hardware are protected.
Model 20012060 $495.CSA-LR51253.



Cuesta Systems Corporation
3440 Roberto Court
San Luis Obispo, California 93401

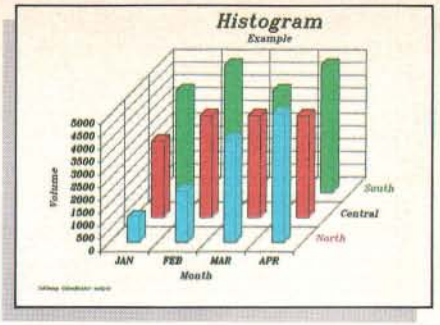
© 1986. Made with pride in the U.S.A.
805/541-4160 TLX:4949381 CUESTA
Dealer, VAR, & OEM inquiries invited.



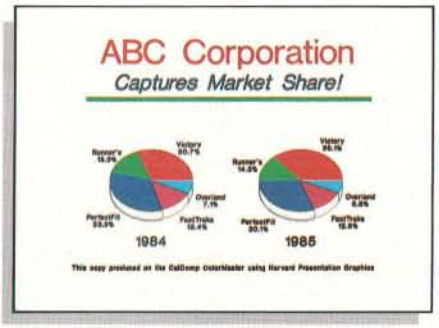
Sign-Master by Decision Resources



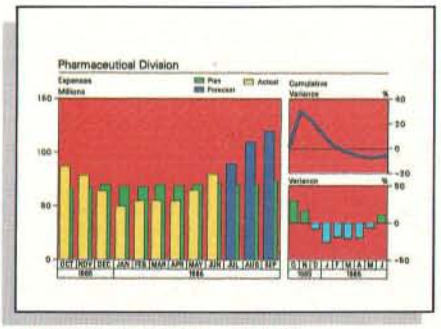
Diagram-Master by Decision Resources



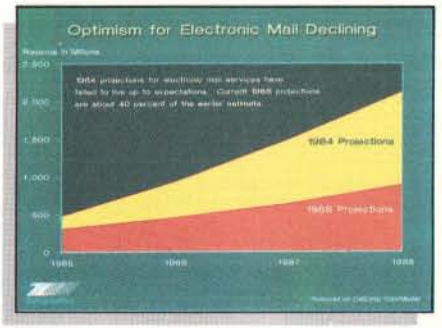
The Smart Series by Innovative Software



Harvard Presentation Graphics by Software Publishing



LINK-A-GRAPH by ISSCO



Mirage by Zenographics

PUT COLOR IN YOUR HANDS, FAST.

ColorMaster® plotter/printer and your PC. That's all it takes to put living color into your presentation. Reports, memos, renderings, even transparencies projected on the screen. All in fantastic full-color. Fast.

You can get a whole page of highly color-saturated graphics printed out in a minute. Or only 20 seconds for a page of printed black and white text.

ColorMaster's speed comes from advanced thermal transfer printing technology. So, quickly and quietly, the ColorMaster plotter/printer can produce high resolution color graphics up to 20 times faster than a pen plotter.

ColorMaster is ready to run with most popular graphics packages you might already be using, like Lotus® 1-2-3,® Chart-Master,™ Dr. Halo™ and more.*

It also has a fully-buffered PC interface which lets you go on working while ColorMaster is printing. What's more, multiple copies can be made without retransmitting data.

Software compatibility. Richly colored graphics. High-speed text. Along with worldwide support, service, and 25 years experience in computer graphics. With CalComp, you get it all.



Call us at 1-800-CALCOMP, or write CalComp, P.O. Box 3250, Anaheim, CA 92803.

CALCOMP

*Some of these software packages include: The Master Series™ from Decision Resources; Packages compatible with General Parametrics Video Show;™ IBM® Professional Graphics;™ ISSCO™ PC LINK-A-GRAPH;™ Smart Series™ from Innovative Software;™ Lotus® 1-2-3,® Symphony;™ Dr. Halo™ from Media Cybernetics; Micro SPSS™ from SPSS Inc; Harvard™ Presentation Graphics from Software Publishing;™ Mirage,™ Autumn,™ Ego™ from Zenographics. © 1986 CALCOMP.

precision when a numeric coprocessor is not present. In that case, Turbo BASIC does all its floating-point arithmetic using 8087 emulation at a much slower pace. And since all floating-point operations must be done in the 80-bit format—even when the operands are single-precision—the slowdown is considerable. For that reason, Borland acknowledges that QuickBASIC will likely outperform Turbo BASIC in single-precision arithmetic when the 8087 chip is not available in the host computer. However, Borland programmers say that version 1 of Turbo BASIC will be close to QuickBASIC 2.0 on double-precision operations, even without the 8087.

The range of word integers (Microsoft's integer type) is -2^{15} to $2^{15}-1$, or −32,768 to 32,767. This range seems especially restrictive in machines with an address space of 2^{24} bytes. The range for Turbo BASIC's long integer types is -2^{31} to $2^{31}-1$, or −2,147,483,648 to 2,147,483,647, which is more than adequate for handling memory address references and other demanding integer-arithmetic problems. Of course, the long integers consume twice as much memory and require more time for processing, but they allow you to do things in integer arithmetic that would require resorting to single-precision in Microsoft BASIC, with the consequent slowdown and introduction of round-off errors.

One good use for the long integer type is with monetary data, where floating-point approaches require extra work to avoid errors in the cents columns. Using long integers and counting money in cents rather than in dollars avoids the problem for dollar amounts up to $21,478,836.47. (The decimal place is dropped into place when the value is printed.)

Our test results using the prerelease version of Turbo BASIC showed the power of the numeric coprocessor, with a predictably degraded speed when Turbo BASIC had to perform 8087 emulation; nevertheless, the answers came out the same (with an 8087 or 8087 emulation). Borland programmers say the times of 8087 emulation will be substantially improved in version 1 of Turbo BASIC.

Recursion is another strong feature of Turbo BASIC not present in QuickBASIC. A function or subprogram may include calls to itself, passing and retrieving parameters in the process. This feature is possible because Turbo BASIC allows local variables—variables that are placed on the stack and initialized each time a module is entered. That way, a parameter is not destroyed when a module is entered recursively; the stacked parameters are removed from the stack one at a time with each exit from the subprogram. Problem-

Table 1: *Enhancements and new features of Turbo BASIC as compared with QuickBASIC 2.0. Unless stated otherwise, QuickBASIC lacks the specified feature.*

Keyword	Description and comments
Metastatements	
$INLINE	Allows inclusion of relocatable machine language code, represented as a sequence of one-byte values. Alternatively, you may specify a file containing the relocatable machine code.
$IF/$ELSE/$ENDIF	Allows conditional compilation of source-code blocks.
$EVENT	Controls the generation of event-trapping code so that not every part of a program has the associated overhead of event trapping.
$COMn	Specifies the size of the communications buffer for COM1 or COM2.
$SEGMENT	Declares a new code segment; this allows a main program to exceed 64K.
$SOUND	Specifies the size of the sound buffer.
$STACK	Declares the size of the run-time stack.
$STATIC	Declares the default array allocation to be static.
$DYNAMIC	Declares the default array allocation to be dynamic.
Statements and functions	
BIN$ function	Returns the binary string equivalent of a number; similiar to HEX$.
CALL statement	Invokes a STATIC, RECURSIVE, or INLINE procedure; in the first two cases, parameters are checked for type and number.
CALL ABSOLUTE statement	Invokes an assembly language routine. Parameters may be specified in the command line or implicitly through values preassigned via the REG function. QuickBASIC lacks the REG function.
CALL INTERRUPT statement	Generates the system interrupt for access to BIOS and DOS functions. Parameters are passed to the system implicitly through values preassigned via the REG function; parameters are returned through the same function. QuickBASIC lacks the REG function.
CEIL function	Returns the arithmetic ceiling, the smallest whole number greater than or equal to its argument.
CHAIN statement	Passes control to a Turbo BASIC chain module (extension .TBC), leaving the run-time module resident; variables declared as COMMON are retained; similar feature in QuickBASIC.
CLNG function	Converts a numeric expression to a long (4-byte) integer.
CVMD and CVMS functions	Convert Microsoft-format double- and single-precision values stored in random disk file format to Turbo BASIC IEEE form, to allow Turbo BASIC program to read Microsoft BASIC random files containing numeric data.
DECR function	Decrements the value of a variable by 1 or by a specified amount; executes faster than the corresponding assignment statement with a subtraction: A=A−1.
DEFLNG statement	Declares the default type for a variable as long integer.
DELAY statement	Causes a pause for a specified number of seconds; independent of the machine's clock speed.
DIM statement	Declares an array; lower bounds and upper bounds may be specified; e.g., DIM GMT(−12|12) QuickBASIC allows only 0 and 1 as lower bounds.

Keyword	Description and comments
Statements and functions	
DO/LOOP statements	Set up a loop with optional WHILE and UNTIL conditions at either end.
ENDMEM function	Returns a long integer representing the end of physical memory.
ERADR function	Returns a long integer representing the position of the most recent error. The value returned can be given to the Runtime error function to find the corresponding place in the source program.
EXIT statement	Allows exiting from a program structure (SELECT CASE, FOR/NEXT, DO/LOOP, WHILE/WEND, IF/END IF, DEF FN, SUB END). More general than QuickBASIC's version.
EXP2 and EXP10 functions	Calculate 2 and 10 raised to the specified power.
FRE function	Returns a long integer representing the number of bytes of free memory in the string area, in the array space, or on the stack, depending on the value of the argument.
GET$ function	Reads a string from a BINARY file.
INCR statement	Increments the value of a variable by 1 or by a specified amount; executes faster than the corresponding assignment statement with an addition: A=A+1.
INSTAT function	Returns a numeric flag indicating whether the keyboard buffer contains any characters; does not remove characters from the buffer.
LCASE$ function	Returns the argument string converted to lowercase.
LOCAL statement	Declares variables in a procedure or function to be local; local variables are stored on the stack and initialized upon each entry to the function or procedure, allowing recursive calls.
MEMSET statement	Declares an upper memory limit to be used by the executable program; address is specified as a long integer.
MKMD$, MKMS$ functions	Convert Turbo BASIC single- and double-precision values to Microsoft random disk file format.
MTIMER statement and function	Function reads, statement resets, the microtimer; accurate to 2 microseconds.
PUT$ statement	Writes a string to a BINARY file.
OPEN BINARY	Opens a file in BINARY mode (not available in Quick statement BASIC).
REG function and statement	Statement sets, function returns, a value in the microprocessor register buffer; used before and after calls to assembly routines and system interrupts. Register is specified as a number from 0 to 9.
SEEK statement	Sets the position in a binary file to a specified byte offset from the beginning.
SELECT CASE statement	Sets up an expression testing and branching block.
SUB/END SUB statement	Defines a subprogram or procedure, which may have any of the following; LOCAL, STATIC, and SHARED variables.
UCASE$ function	Returns the argument string in all uppercase.

solving routines that apply the same logic steps at various levels are naturals for recursion, as are many mathematical routines such as factorials (see photo 2).

Turbo BASIC adds two block structure elements that are available in True BASIC but not in QuickBASIC 2.0: DO/LOOP with WHILE and UNTIL conditions at the beginning or end of a block and SELECT CASE structures. Both constructs are key features of any structured language, allowing programs to be written in a way that corresponds to the logical structure of a problem at hand.

Another Turbo BASIC feature absent from QuickBASIC (but present in True BASIC) is programmable lower bounds for arrays. For instance, an array called moderntimes might be set up with a lower bound of 1920 and an upper bound of 1987, using the statement

```
DIM moderntimes (1920|1987)
```

Table 1 summarizes the highlights (new or enhanced keywords) of Turbo BASIC as compared with QuickBASIC 2.0.

Conclusions

Will Turbo BASIC be another Turbo Pascal? It offers many of the features that made that language such a smash hit: the production of stand-alone executable applications; no royalties or licensing fees; a versatile, intuitive user interface; a good program editor; fast compilation; fast execution of completed applications; and significant enhancements or additions to the "standard" language. The big difference is that Turbo Pascal didn't have to confront a popular de facto standard like Microsoft BASIC.

For the time being, Turbo BASIC offers some significant advantages over QuickBASIC 2.0. Chief among these are 8087 support in hardware and emulation; production of executable, royalty- and license-free programs; recursion; and conditional compilation.

Using just a preliminary version of Turbo BASIC, it is not possible to get definitive timings of Turbo BASIC's executable programs in the absence of an 8087. However, it is clear that with the 8087 available, Turbo BASIC vastly outperforms QuickBASIC. (See the performance chart.)

At the very least, the arrival of Turbo BASIC will certainly apply further pressure to Microsoft to make some long overdue changes in the company's flagship programming language. In the meantime, since Turbo BASIC costs just $99.95 and is generally compatible with Microsoft QuickBASIC, BASIC programmers and would-be BASIC programmers should take a close look at Borland's new baby. ■

COMPATIBLE DESIGN. INCOMPARABLE PERFORMANCE. INCREDIBLE VALUES.

CHOOSE FROM THESE COMPLETE SYSTEMS.

PC'S LIMITED TURBO PC™

Monochrome Systems

- Intel 16-Bit 8088-2 System Unit running at 4.77 MHz and 8.0 MHz
- 640K on Motherboard
- AT™-Style Keyboard
- 130 Watt Power Supply
- Hercules Compatible Graphics Adapter with one Parallel Port
- PC's Limited Mono-IIA Flat Screen Monochrome Monitor with Tilt and Swivel Base

with two 360K Floppy Disk Drives— $859

with one 360K Floppy Disk Drive and one 20 Meg, 65 MS Hard Disk Drive— $1199

EGAds! Color Systems

- Intel 16-Bit 8088-2 System Unit running at 4.77 MHz and 8.0 MHz
- 640K on Motherboard
- AT™-Style Keyboard
- 130 Watt Power Supply
- PC's Limited EGAds! Card
- PC's Limited EGAds! Monitor

with two 360K Floppy Disk Drives— $1229

with one 360K Floppy Disk Drive and one 20 Meg, 65 MS Hard Disk Drive— $1589

PC's Limited 286[8]

Monochrome Systems

- Intel 80286 running at 8 MHz
- 1024K on Motherboard
- 1.2 Meg Floppy Disk Drive
- Combined Floppy and Hard Disk Controller
- AT™-Style Keyboard
- 192 Watt Power Supply
- Clock/Calendar with Battery Backup
- Hercules Compatible Monochrome Graphics Card
- 2 Serials and 2 Parallel Ports
- PC's Limited Mono-IIA Flat Screen Monochrome Monitor with Tilt and Swivel Base

with 20 Meg, 65 MS Hard Disk Drive, Space Saving Chassis— $1795

with 30 Meg, 40 MS Hard Disk Drive, AT™ Standard Chassis— $2195

EGAds! Color Systems

- Intel 80286 running at 8 MHz
- 1024K on Motherboard
- 1.2 Meg Floppy Disk Drive
- Combined Floppy and Hard Disk Controller
- AT™-Style Keyboard
- 192 Watt Power Supply
- Clock/Calendar with Battery Backup
- PC's Limited EGAds! Card
- 2 Serials and 1 Parallel Ports
- PC's Limited EGAds! Monitor

with 20 Meg, 65 MS Hard Disk Drive, Space Saving Chassis— $2195

with 30 Meg, 40 MS Hard Disk Drive, AT™ Standard Chassis— $2595

PC's Limited 286[12]

Monochrome Systems

- Intel 80286 running at 12 MHz
- 1024K on Motherboard
- 1.2 Megabyte Floppy Disk Drive
- Combined Floppy and Hard Disk Controller
- AT™-Style Keyboard
- 192 Watt Power Supply
- Clock/Calendar with Battery Backup
- Hercules Compatible Monochrome Graphics Card
- 2 Serials and 2 Parallel Ports
- PC's Limited Mono-IIA Flat Screen Monochrome Monitor with Tilt and Swivel Base
- AT™-Standard Chassis

with 30 Meg, 28 MS Hard Disk Drive— $3095

with 40 Meg, 28 MS Hard Disk Drive— $3295

EGAds! Color Systems

- Intel 80286 running at 12 MHz
- 1024K on Motherboard
- 1.2 Megabyte Floppy Disk Drive
- Combined Floppy and Hard Disk Controller
- AT™-Style Keyboard
- 192 Watt Power Supply
- Clock/Calendar with Battery Backup
- PC's Limited EGAds! Card
- 2 Serials and 1 Parallel Ports
- PC's Limited EGAds! Monitor
- AT™-Standard Chassis

with 30 Meg, 28 MS Hard Disk Drive— $3495

with 40 Meg, 28 MS Hard Disk Drive— $3695



(Tape backup optional)

A GUARANTEE THAT STANDS UP.

PC's Limited has established itself as the leader in PC technology. And the guarantee and warranty programs we offer put us ahead of the pack, too. Here are our terms in plain English.

30-Day Total Satisfaction Guarantee—Any item bought from PC's Limited may be returned within 30 days from the date it was shipped for a full refund of your purchase price. Returned items must be as-new, not modified or damaged, with all warranty cards, manuals, and packaging intact. Returned items must be shipped prepaid and insured, and must bear a PC's Limited Credit Return Authorization (CRA) on the shipping label.

One Year Limited Warranty—PC's Limited warrants the products it manufactures to be free from defects in materials and workmanship for one year following the date of shipment from PC's Limited. During the one year warranty period, PC's Limited will repair or replace, at its option, any defective products or parts at no additional charge, provided that the product is returned, shipping prepaid, to PC's Limited.

PC'S LIMITED

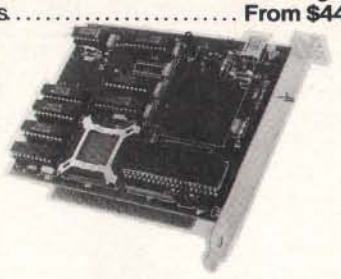
To buy PC's Limited computers, call us directly at 1-800-426-5150.
Calls inside Texas, 1-800-252-8336.

1611 Headway Circle, Building 3, Austin, Texas 78754
Sales Calls from anywhere in the country, (512) 339-6962, Technical Support Calls, 1-800-624-9896 or PC's Limited BBS (512) 339-4127
Customer Service Calls, 1-800-624-9897 or MCI MAIL: PC's Limited, Telex No. 9103808386 PC LTD FAX (512) 339-6721

MICROWAY MEANS 8087 PERFORMANCE

FastCACHE-286™

Runs the 80286 at 8.5 or 11 MHz and the 80287 at 5, 6 or 11 MHz. Includes 8 kbytes of 55ns CACHE. Works with more PCs than any other accelerator, including Leading Edge Model D, Compaq, and Turbo motherboards. Includes 8088 Reboot Switch, DCache and Diagnostics..... **From $449**



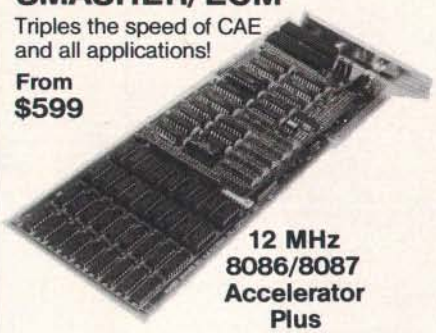
8087 SOFTWARE

IBM BASIC COMPILER	$465
MICROSOFT QUICK BASIC	$79
87BASIC COMPILER PATCH	$150
IBM MACRO ASSEMBLER	$155
MS MACRO ASSEMBLER	$99
87MACRO/DEBUG	$200
MICROSOFT FORTRAN	$209
RM FORTRAN	$399
LAHEY FORTRAN F77L	$477
MS or LATTICE C	CALL
STSC APL★PLUS/PC	$450
STSC STATGRAPHICS	$675
SPSS/PC+	$675
87SFL Scientific Functions	$250
PHOENIX PRODUCTS	CALL
FASTBREAK for 1-2-3 V.1A	$79
HOTLINK for 1-2-3 V.1A	$99

NUMBER SMASHER/ECM™

Triples the speed of CAE and all applications!

From $599



12 MHz 8086/8087 Accelerator Plus A Megabyte for DOS!

For the IBM PC, XT and compatibles

***PC Magazine* "Editor's Choice"**

DATA ACQUISITION and REAL TIME TOOLS

Unkelscope™ – A real time data acquisition, control and process software pkg.

87FFT™ – The fastest PC FFT package available! Written in assembly language, it performs forward and inverse FFTs on real and complex arrays occupying up to 512K of RAM. Callable from most 8087 compatible compilers..... **$200**

87FFT-2™ – For two dimensional FFTs.

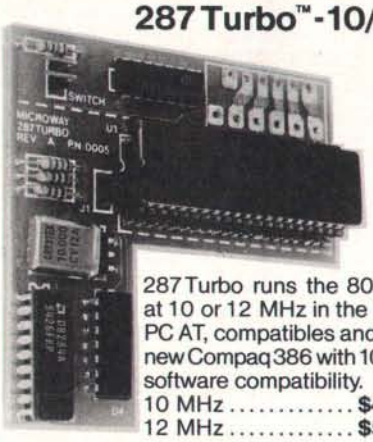
TransView Menu driven FFT Spectrum/transfer analyzer..... **$250**

RTOS – REAL TIME OPERATING SYSTEM

A multi-user, multi-tasking real time operating system. Includes a configured version of Intel's iRMX-86, LINK-86, LOC-86, LIB-86, OH-86. For the PC, XT, AT and COMPAQ..... **$600**

INTEL COMPILERS Available for RTOS!

287 Turbo™-10/12



287 Turbo runs the 80287 at 10 or 12 MHz in the IBM PC AT, compatibles and the new Compaq 386 with 100% software compatibility.

10 MHz..... **$450**

12 MHz..... **$550**

***PC Magazine* "Editor's Choice"**

8087 UPGRADES

All MicroWay 8087s include a one year warranty, complete MicroWay Test Program and installation instructions.

8087 5 MHz..... **$114**
For the IBM PC, XT and compatibles

8087-2 8 MHz..... **$149**
For Wang, AT&T, DeskPro, NEC, Leading Edge

80287-3 5 MHz..... **$179**
For the IBM PC AT and 286 compatibles

80287-6 6 MHz..... **$229**
For 8 MHz AT and compatibles

80287-8 8 MHz..... **$259**
For the 8 MHz 80286 accelerator cards

80287-10 10 MHz..... **$395**
For the Compaq 386

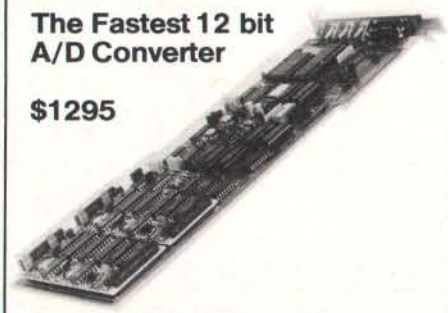
INTEL Above BOARD..... **CALL**

Call for prices on V20, V30, 64K, 128K and 256K RAM

A2D-160™

The Fastest 12 bit A/D Converter

$1295



160,000 Samples per second
Pseudo Random Noise Generator/DAC
Optional signal conditioners
AFM-50™ Programmable Low Pass Filter Module..... **$225**

MICROWAY SOFTWARE FOR THE 8087

FASTBREAK for 1-2-3
HOTLINK for 1-2-3
MATRIXPAK, 87SFL
OBJ-ASM
DFixer, DCache, DOptimizer
87BASIC, 87BASIC/INLINE
87MACRO, 87DEBUG
87VERIFY, 87TEST

PC-PAL™ PROGRAMMER

The simple, fast and inexpensive way to program PALs in your PC or AT. Works with virtually all 20 and 24 pin devices from MMI, TI and NSC. Includes all the software needed to read, write and verify PALs. Works with JEDEC files and includes a compiler for MMI standard PAL types..... **$395**

287 TURBO-PLUS™ Speeds up your AT

Adjustable 80286 Clock 6-12 MHz
10 MHz 80287 Clock
Plus Full Hardware Reset..... **$149**
Optional 80286-10..... **$175**



287TURBO-PLUS
With 80287 10 MHz..... **$549**
With 80287 12 MHz..... **$629**

CALL (617) 746-7341 FOR OUR COMPLETE CATALOG

MicroWay
P.O. Box 79
Kingston, Mass.
02364 USA
(617) 746-7341

The World Leader in 8087 Support!

MicroWay Europe
32 High Street
Kingston-Upon-Thames
Surrey England KT1 1HL
Telephone: 01-541-5466

Inquiry 194

Steve Ciarcia

Build a Trainable Infrared Master Controller

This device can control all your home entertainment equipment

First of all, this is not the second part of a two-part article. As you will come to understand, this month's project is the solution to a problem I aggravated by building last month's project (an infrared remote control for my home control system). Confused? Let me explain.

While people residing in warm climates tend toward Jacuzzis and hot tubs, some of us who live in colder climates prefer not to tempt fate and brave the elements for about six months of the year. Of course, I could succumb to the winter sports thing. You know, skiing, skating, snow this, and snow that, but it would be much too great a chore at this stage to reorient my sedentary lifestyle to enjoy northeast winters. I hibernate like most indigenous mammals and wait for the color outside the window to metamorphose from white to green.

About a year ago, I decided that holing up in the cellar for six months a year was antisocial. While the isolation proved beneficial in coming up with great projects for the summer and fall issues, I did find that by the time March rolled around, I looked very much like a bear that was leaving his cave, and I communicated just about as well.

In an attempt to improve the quality of winter life and break the cycle of hibernation, this last year I decided to spend some of the time aboveground (upstairs) in an environment that allowed me to observe the realities of my existence (through the windows) and absorb the cumulative knowledge of our culture (watch TV).

In layman's terms, I built a media room. Not just a TV den, mind you, but a room where I could be immersed in a synthesized environment so far from the ice and snow that six months seemed like overnight. Of course, this audiovisual experience was tastefully produced by massive amounts of electronic equipment.

The beautiful scene of the tropical island was accurately reproduced on a Kloss 2000 projection TV. You'd think you were sitting next to that tinkling waterfall as the music moves above and around you in complete surround sound. And when the warm breeze of island spring (actually the heat wafting from the seven amplifiers) is tumultuously interrupted by a hurricane faithfully reproduced with 2400 watts of Nakamichi audio power through a pair of B&W 808s (180 pounds each), two Speakerlab subwoofers, and 11 Canton surround speakers, you feel like the walls are about to explode. Sometimes it is good not to have neighbors.

Enough of warm breezes. I now had a new problem. In addition to all the audiovisual stuff, there were a couple of VCRs, an FM tuner, and a CD player. All this equipment required the 14 remote handheld controls shown in photo 1. Media rooms are a great idea, but you can't expect people to glue a dozen remotes on a long board. There had to be a better way.

IR Master Controller to the Rescue

This month's project, an infrared Master Controller that takes charge of all your gadgets, can prevent "controller clutter." It "learns" the infrared signals for each function and plays them back on command. It uses a six-button keypad to select the device and functions, shown on a two-line LCD, and a single button, Do It, to execute what's selected.

I am not the first person to design a trainable remote control. More than a year ago, I bought a similar device made by General Electric, called Control Central. This device could be trained to simulate the functions of four remotes.

Control Central and similar commercial units have two major shortcomings. First, all the acquisition, data-reduction, processing, and memory circuitry is contained in the single hand-held unit. Given the finite physical size of today's integrated circuitry, there is a limit to the capacity of such a device that allows it to still be cost-effective. Second, it is designed for use by a mass audience assumed to have a finite set of electronic devices. The buttons have predesignated nomenclature, so it is not user-programmable.

You can still train your GE controller to simulate the remote control for your CD player. The Mute button on the GE unit could be trained to be the Auto Repeat on your CD player remote, for example. Unfortunately, every time you want to repeat a CD, you'll have to remember to press Mute since there is no Repeat button on the GE.

I am not criticizing the GE Control Central. I am merely making a case for designing something different for a very vertical, gadget-happy, affluent audience: BYTE readers. Why tie a design to the lowest common denominator. Instead, yell "let them eat cake" and demand the remote to end all remotes: the Circuit Cellar Master Controller!

The shortcomings of the GE and other trainable remotes are the strengths of the Master Controller. Rather than attempt to contain all the necessary intelligence and processing circuitry, the Master Controller temporarily utilizes an external computer

continued

Steve Ciarcia (pronounced "see-ARE-see-ah") is an electronics engineer and computer consultant with experience in process control, digital design, nuclear instrumentation, and product development. The author of several books on electronics, he can be reached at P.O. Box 582, Glastonbury, CT 06033.

COPYRIGHT © 1987 STEVEN A. CIARCIA. ALL RIGHTS RESERVED.

Infrared controllers are not compatible because each manufacturer speaks in a different language.

as a user-programmable interface. Also, rather than having buttons with fixed-function nomenclature, the Master Controller incorporates a scrolling LCD to identify unit designations (devices) and functions (commands). Device designations like "Bedroom VCR" or "Nakamichi preamp" and commands like "CD repeat/all" or "slow motion" are used instead of remembering what the Mute button was supposed to do.

The Master Controller uses an IBM PC for training. After that, it is battery-operated and completely independent. The IBM PC is connected to the Master Controller via an RS-232 interface and is used to set up menus of devices (receivers, CD players, tape decks) and functions for each device (turn on, play forward, etc.). After a menu is downloaded to the Master Controller, each function is "taught" and tested. Next, the completed menu and synthesis data are then uploaded to the IBM PC and stored on disk (in case you want to load it into another Master Controller or add another device later without retraining all of them).

The Master Controller's IBM PC program can also combine sets of infrared signals once they are trained for their respective devices. I can now use a single Master Controller button to turn on the audio system, route the output to the living room, select the CD player, move to the third selection, and repeat it forever. Compared to other commercial controllers, the Master Controller solves the IR remote plague hands down. Because it uses an external computer for functional modifications by the user, more room is available for its ultimate task. Instead of four remotes, the Master Controller can be trained to simulate the functions of 16 individual remote controls complete with descriptive command designations.

An Infrared Introduction

Most infrared remote controls are functionally similar. The microprocessor in the remote controller creates a stream of bits that is turned into on/off pulses of IR light from an IR LED. An IR-sensitive photodiode in the receiver turns the light pulses back into an electrical signal from which the original bits can be extracted.

The IR LED's fast on-and-off action creates a carrier signal. The carrier is then turned on and off to form the individual bits of the message. Each controller uses a different carrier frequency, sets different bit timings, and assigns different meanings to the bits in the message. The reason that controllers are not compatible is that there is no standard for the format of the bits in the message. Each manufacturer speaks in a different language.

The Master Controller sidesteps this problem by simply recording and playing back the infrared signals without attempting to decode the messages. It's just like a tape recorder. You can record English, Russian, and Spanish on the same tape because they all occupy the same frequency bands, and you don't have to understand the languages to play them back.

This scheme works because of a limited range of differences in the IR signals. The controllers I've tested had carrier frequencies ranging from 32 to 48 kilohertz. Each message bit has between 10 and 30 carrier cycles, and there are two different carrier modulation systems: pulse-width modulation and pulse-position modulation. Last month I explained pulse-width modulation. Pulse-position modulation works by determining the time when a bit occurs relative to a fixed starting point.

The Heart of the Master

An Intel 8031 single-chip microprocessor running a program stored in a 2764 EPROM directs the operation of the rest of the circuitry. (See photos 2 and 3 and figure 1.) The menus and IR signals are stored in a single 32K-byte battery-backed static RAM. The user interface consists of a two-line LCD and a six-button keypad. The keypad is either a simple membrane matrix or individual keys arranged in a matrix that is scanned by the 8031. This eliminates the need for a keyboard encoder. Two keys each are used for device and function up/down scrolling on the LCD. A fifth button, Do It, executes the device/function command appearing on the display. A sixth button, Learn, is used for training.

The LCD has 20 characters on each of two lines. The interface to it requires only six wires: four data bits, one timing strobe, and an address line. The display's internal character generator converts ASCII data into character dots, so the 8031 can communicate directly in ASCII.

A TIL413 photodiode converts the IR signals from other remote controllers into a discernible logic signal. Because the Master Controller and the remote are placed close together during training, there is no need for the sophisticated signal processing that's required to detect weak IR signals across a room. The Master Controller photodiode circuitry was designed to accept strong IR signals only. You should position the remote-control unit within a few inches of the Master Controller's photodiode. If it's too far away, the Master Controller will "see" nothing. If it's too close, the Master Controller will receive a distorted signal. A little experimenting with each controller will locate the correct position.

An LM311 comparator converts the photodiode input signal to a TTL-level signal. A 74LS164 shift register samples the output from the LM311 at a 1-megahertz rate and converts the data into



Photo 1: *The six-button Master Controller can duplicate the functions of the 14 controllers shown in the background.*

parallel format. The 8031 reads the shift register every 8 microseconds while it is learning a new IR signal. This data is stored in RAM for later analysis.

At the transmitting end, the process is reversed. Although the 8031 is a fast microprocessor, it cannot generate both the carrier and bit timing of the IR signals instantaneously. To lighten the processing overhead, an 8254 programmable interval timer controls the IR carrier frequency and duty cycle as well as the duration of each message bit. The 8031 sets up the 8254's registers for each bit of the IR message.

A pair of TIL39 infrared LEDs produce the IR signal. Because the human eye cannot see IR light, a visible LED is connected in parallel as an indicator. The LEDs are switched by a field-effect transistor driven by a standard logic gate. The FET is an efficient way to interface logic levels with real-world devices because it directly translates an input voltage into an output current.

Power

Power is an important consideration in any battery-operated device. The Master Controller was designed to use either 74LS or 74HC devices at 5 volts. The 5 V is derived from a 6-V battery (four AA cells) using a special low-dropout voltage regulator. While LS takes considerably more power than HC, the duty cycle is low. The Master Controller need only be powered up long enough to set the device and function and press Do It. It can be shut off afterward. Admittedly, I could have spent more time developing automatic power up/down circuitry, but it would have complicated the design and added more software. Feature-specific circuit tailoring will have to wait.

Turning the power on and off is not a problem. The 8031's system software is contained in a 2764 EPROM, and the LCD and IR data are contained in battery-backed RAM. The memory is a 32K by 8-bit static low-power CMOS RAM chip. The backup circuit consists of two 3-V lithium batteries and a Dallas Semiconductor DS1210 battery-backup controller chip. The DS1210 senses loss of the +5-V supply voltage and automatically write-protects the RAM as it switches power to the battery. The second battery is necessary only if the first one fails.

Signal Processing

As you can see from the schematic in figure 1, most of the Master Controller's functions are done in software. It's worthwhile to look more closely at the processing required for the learning and reproduction of the IR signals. The IR carrier frequency is about 40 kHz, giving a period of about 25 μs. The particular frequency used by a controller must be measured precisely because each microsecond of error changes the reproduced frequency by about 4 percent. While this doesn't sound like much, when the Master Controller reproduces the IR signal, the receiver could completely ignore it. The reason for this is that the IR receivers in consumer electronic gear must detect faint IR signals.

Generally, the receivers use a phase-locked loop, tuned to the remote unit's carrier frequency. The PLL can handle a 10 to 20 percent frequency error, but the design margins include errors due to temperature, voltage, and other effects.

continued

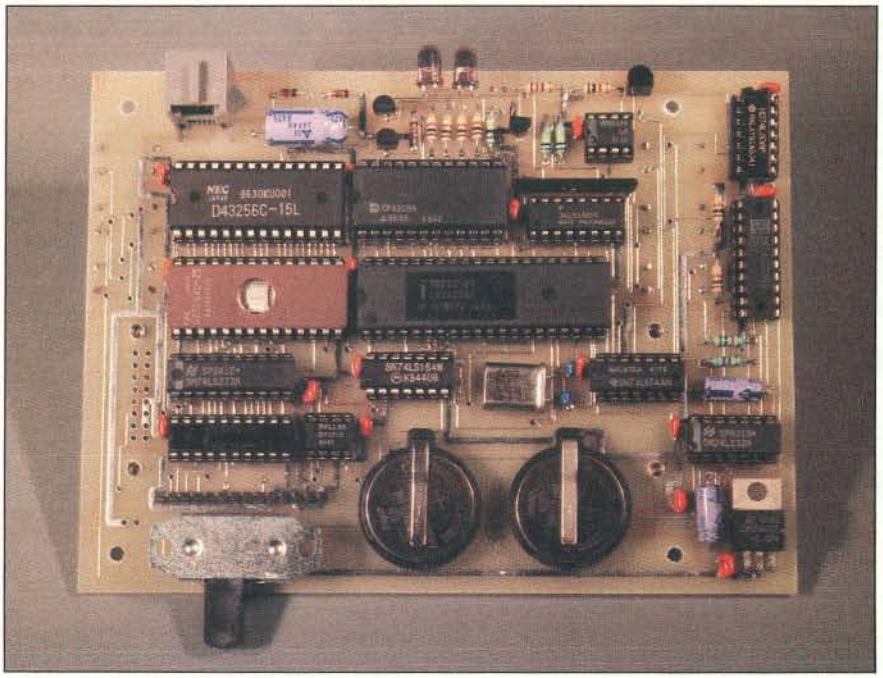


Photo 2: *Component side of the Master Controller, showing the 2764 EPROM and 8031 CPU (center left and right). The backup batteries and Dallas Semiconductor DS1210 battery controller are in the bottom center and right.*

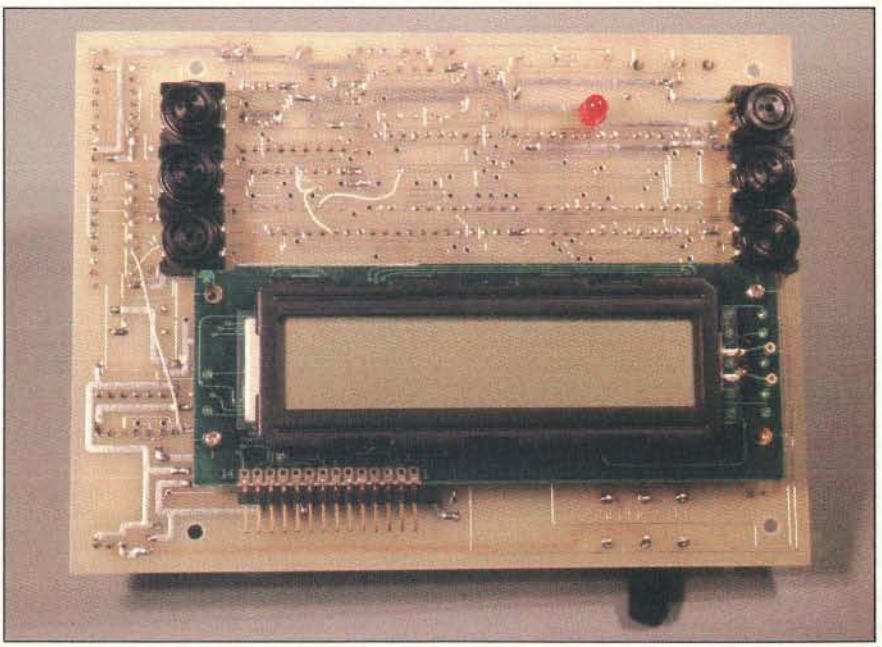


Photo 3: *The etch side of the Master Controller showing the 2-line by 20-character LCD and six control buttons.*

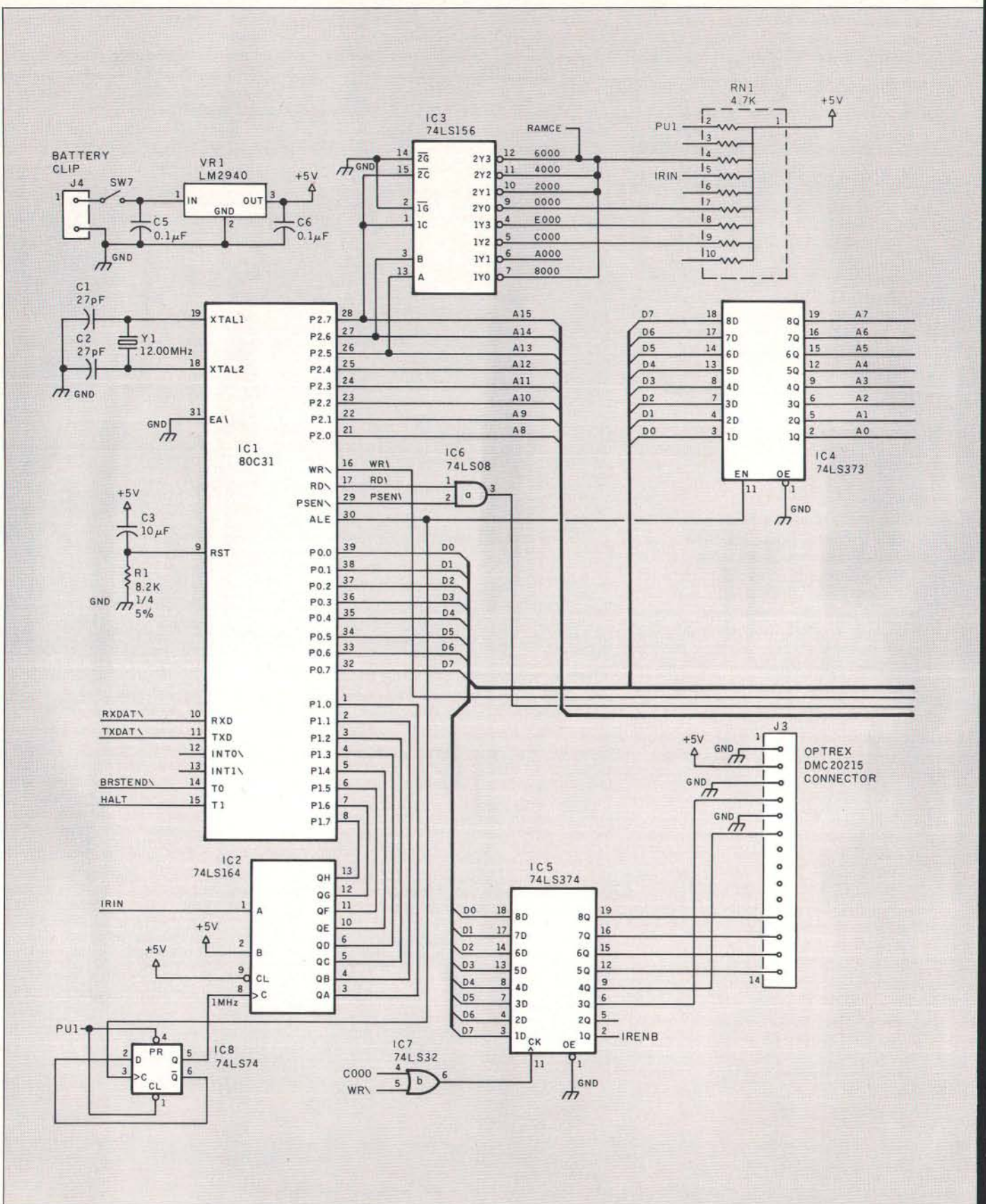
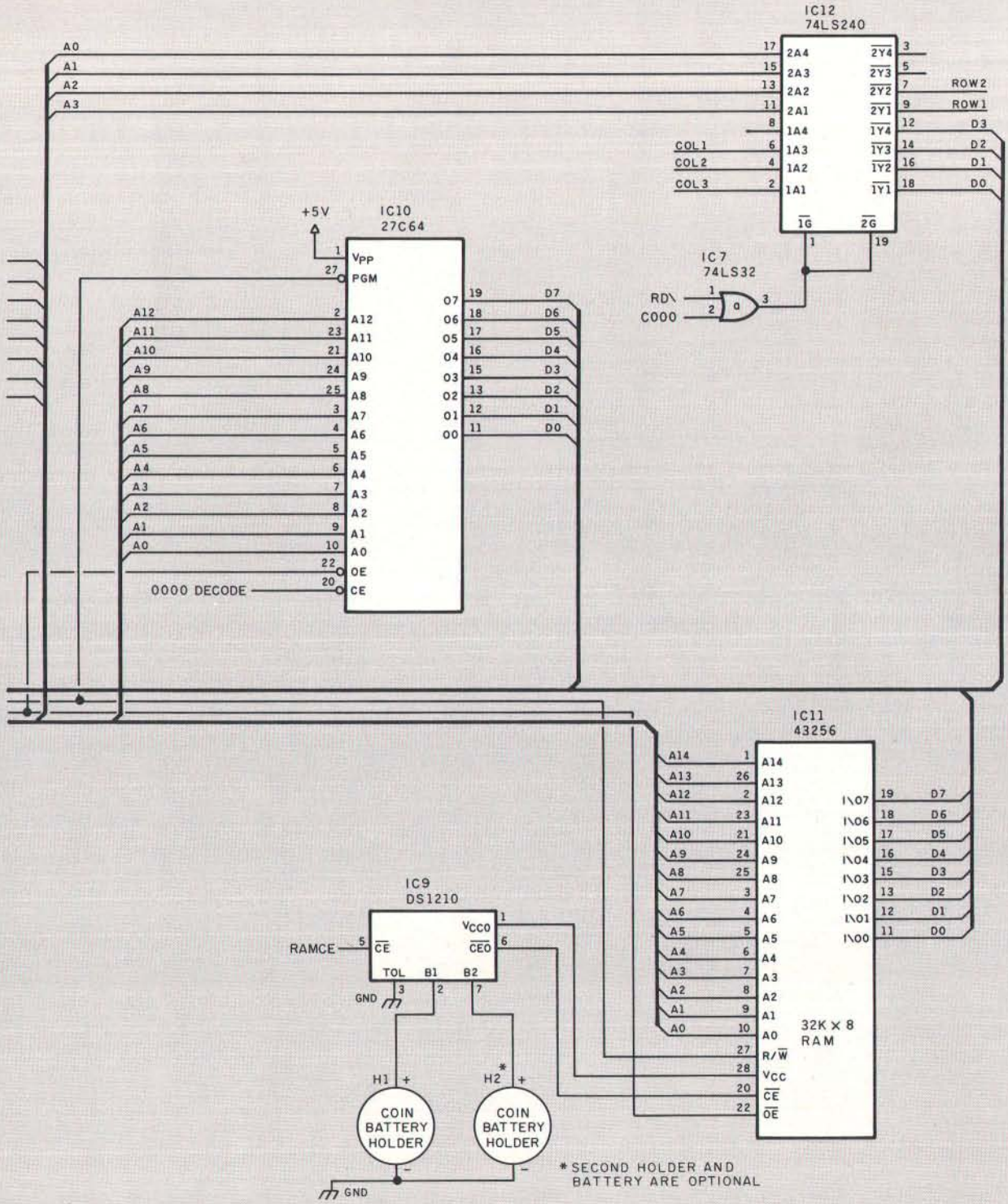


Figure 1: *Master Controller schematic diagram.*


IC12
74LS240
A0
A1
A2
A3
COL1
COL2
COL3
ROW2
ROW1
D3
D2
D1
D0
IC7
74LS32
RD\
C000
+5V
IC10
27C64
VPP
PGM
0000 DECODE
IC11
43256
32K X 8
RAM
IC9
DS1210
RAMCE
GND
H1
H2
COIN
BATTERY
HOLDER
* SECOND HOLDER AND
BATTERY ARE OPTIONAL

The whole margin isn't available for the Master Controller. An 8031 with a 12-MHz crystal can execute most instructions in 1 or 2 μs. The shortest possible loop used to sample an input pin takes 2 μs. While this might seem very fast to you, reading and storing the value takes much longer and necessitates some form of input buffering.

The solution involves using a 74LS164 shift register to accumulate 8 bits of IR signal at a 1-MHz clock rate (see figure 2). The shift register in turn is sampled once every 8 μs, a requirement that's easily met. The 1-MHz clock for the shift register (and also the 8254, which I'll describe in a moment) is derived from the 8031's address latch enable output. The ALE signal occurs at a 2-MHz rate and is divided down to 1 MHz by half of the 74LS74 flip-flop. Exactly 32 samples of the shift register data are copied into internal RAM, a process that accumulates 256 μs of IR signal. The software then examines the data to pick out the start and stop of each carrier pulse. The 256-μs sample will include 8 to 12 complete carrier pulses, depending on the exact frequency (generally, 32 to 48 kHz). The software averages the length of the pulses to compute the carrier period and also determines the average duty cycle. Using several samples reduces the effect of noise on the final average.

Once the carrier frequency is determined, the next step is to measure the length of each bit in the message. The shortest bits we've measured contain at least 10 carrier pulses, and the average seems to be about 20 (although some contain more than 60 pulses). Given the variability in carrier frequency and pulse length, the main problem lies in determining when the bit ends. The software assumes that 32 μs without an IR signal marks the end of a bit.

The duration of each bit and the following pause are recorded in the external RAM of the 8031. Each IR message can contain up to 256 bits (and the following pauses) and can last up to half a second. Because most remote controllers repeat the message as long as the key is held down, it is very important to tap that key lightly.

Although the carrier frequency and message analysis could be done on one sample of the IR signal, the Master Controller requires two separate samples. The first is analyzed for carrier frequency, the second for message bits (see figure 3). This reduces the chances that a partial signal will be recorded in case the first bit is less than 256 μs long. Each IR signal is summarized by its carrier frequency and duty cycle and up to 256 pairs of 16-bit numbers that record the bit times. Therefore, each signal can occupy up to about 1K byte of RAM. Typical signals have a few dozen bits and require only about 100 bytes. This allows the Master Controller to easily accommodate 16 remote-control units with 16 commands each.

Just as the 8031 isn't quite fast enough to directly record the IR signals, it needs a little help creating them. An 8254 programmable interval timer provides the high-speed logic required to generate signals with microsecond timing resolution. The 8254 PIT contains three identical timers that can be set up in a bewildering variety of modes. The Master

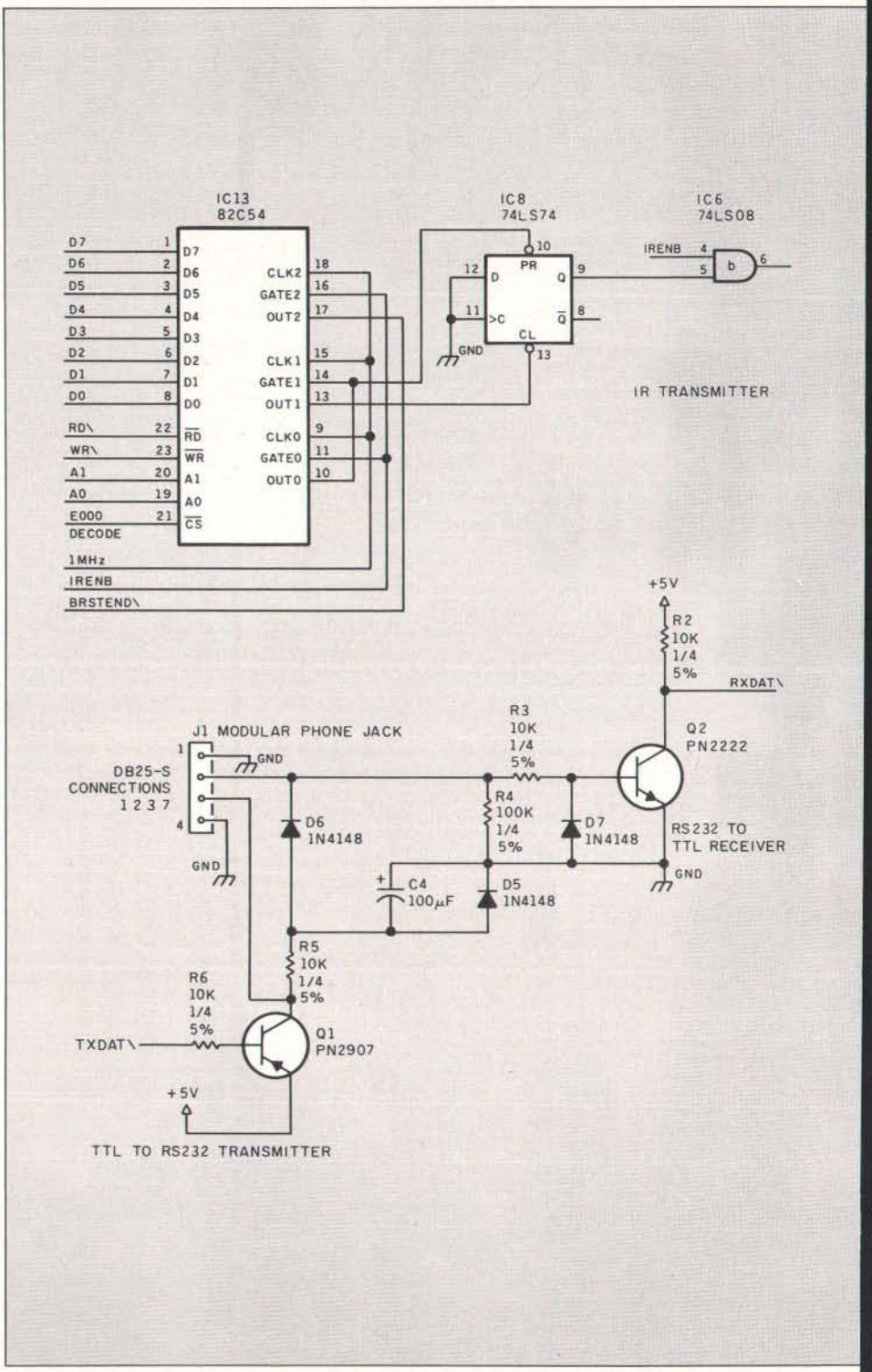
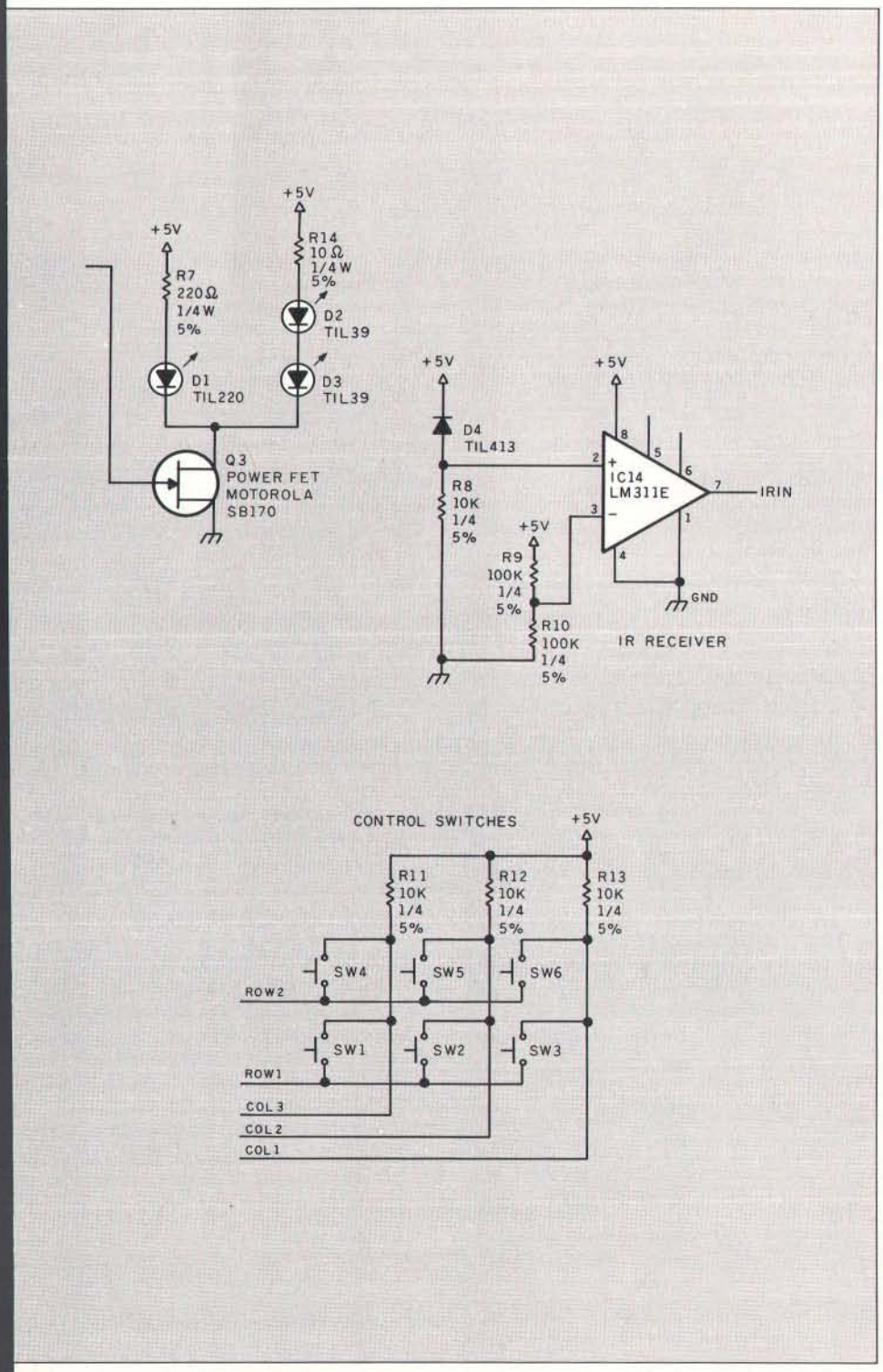


Figure 1: *Continued.*

Controller software uses all three of them, as well as a timer inside the 8031, during the IR playback.

Timers 0 and 1 in the 8254 (IC13) set the IR carrier frequency and duty cycle, respectively. Timer 2 determines the duration of each message bit, and the 8031 timer controls the pause following each bit. The first two timers are set once at the beginning of the message, while the last two are set for each bit. The times are stored in external data RAM accessed only when the 8031 is running.

Because the 8254 produces a pulse only at the end of each timer's count, a 74LS74 (IC8) is used to create the actual IR pulses. The Timer 0 pulse (pin 10 of IC13) sets the LS74's output at the start of the carrier cycle, with Timer 1 (pin 13 of IC13) resetting the output at the end of the carrier pulse. The LS74's output is combined with a gating signal (IRENB) and sent to the IR LED drivers. As you can see, a great deal of code is required to handle the IR signal analysis. The code is written in 8031 assembly language.



The PC Connection

Using an IBM PC to create menus for the Master Controller may seem like overkill, but it really simplified the logic. The PC has a full keyboard and display, disk storage, and, best of all, high-level programming languages. Writing a PC program is much easier than writing an 8031 program, so I decided to put as little code in the Master Controller as possible.

The PC program (called MASTER) provides three main operations: creating and editing menus of devices and functions, saving and loading these menus in disk files, and transferring them to and from the Master Controller. (See photos 4, 5, and 6.) The Master Controller is connected to the PC only when uploading and downloading menus. Under normal use, the Master Controller doesn't have any wires trailing out of it.

I'll have to admit to taking a little poetic license in the design of the RS-232 circuit. Rather than include a separate negative-voltage power supply for the RS-232 signal levels, I used a diode and capacitor to "borrow" the negative voltage from the PC's transmitted data line. A pair of transistors are simpler than the power-hungry level converters normally used to translate between logic levels and RS-232 levels. This is an important consideration in battery-operated devices. Because I know the communication will always be with an IBM PC, a worst-case, tolerant RS-232 circuit is not a necessity.

The serial connector is an RJ-11 telephone jack instead of the usual 25-pin DB-25 connector. Only three wires are required: data from the PC, data to the PC, and signal ground. Because the MASTER program and the Master Controller were designed together, they use an efficient method of passing data that doesn't require the normal RS-232 RTS/CTS and DSR/DTR status lines.

The 8031 serial interface includes a bit-rate generator. The exact bit rate depends on a number programmed into a register as well as the frequency of the 8031's clock crystal. I used a 12-MHz crystal to get the highest resolution possible for the IR signal-processing circuitry, but that's not the optimum crystal for the serial interface. As a result, the 8031 transmits data

continued

The MASTER program, which is written in Turbo Pascal, can create menus for up to 16 devices.

to the PC at 10,417 bits per second. If you're familiar with normal RS-232 data rates, you'll recognize that 10,417 isn't one of the choices. Fortunately, the PC's serial port also determines the bit rate from a number in a register. The closest match is 10,473 bps, but everything works just fine.

Here I should point out that, although the link between the Master Controller and the PC is called RS-232, it is surely not standard. For example, using mismatched bit rates and voltage levels is acceptable only if you've carefully checked out the consequences and assured yourself that both ends of the connection are still compatible. If you elect to build a Master Controller, you shouldn't try to stretch the limits of the connection too much. A 50-foot cable probably won't work at all!

The Master in Action

Perhaps an example of how to use the Master Controller is in order. I'll show how to set up the first menu, then how to combine IR signals to produce customized effects.

The MASTER program, written in Turbo Pascal, can create menus for up to 16 devices: receivers, CD players, tape decks, and so on. Each device can have up to 16 functions (on/off, play, rewind, volume up, etc.). While up to 256 functions are possible, the ultimate limit to the number of devices and functions is the size of the Master Controller's RAM. MASTER and the Master Controller cooperate to make sure that you don't download a menu that's too big.

MASTER treats the devices (Bedroom VCR, Kitchen TV, etc.) and functions (volume up, power on, etc.) as a collection of lists. Function keys let you "cut" an item from one list and "paste" it elsewhere (see photo 4). You can delete an item permanently, and you can insert a new item and give it a name. Devices and functions are treated as different items, so you can't cut a function and then paste it into the device list.

Table 1 shows the complete list of MASTER function keys on the IBM PC. As an example, you might use the MASTER screen for the Sony RM-S750 controller menu. The Tape Deck line in the Devices list is highlighted, and the Functions list details all the tape deck's functions. The word "new" at the end of each function indicates that the IR signals have not been learned yet (see photo 6).

The Remote Keyboard item in the Devices list contains the general functions like power on/off and volume up/down as well as the digits from 0 to 9 to allow direct radio tuning. You can duplicate functions under more than one device to make the Master Controller easier to use. After all the devices and function names have been entered, you should save the menu on disk. A good choice for a filename is the manufacturer's model number, so RM-S750 is a good choice for this one. The MASTER program will automatically supply an .MC file extension.

The next step is to download the menu to the Master Controller. The MASTER program and the 8031 program first verify that each other exists, exchange some status information, and finally transmit the menu. (The PC cable can be disconnected after the download is complete.) The Master Controller learns one function at a time. Use the Select Device keys to scroll through the Devices list, then the Select Function keys to pick a function for the device. The Learn key will record an IR signal for the selected function. You can test the signal and relearn it until it's correct, but you can learn only one signal for each function.

As I described earlier, the Master Controller requires two samples of the IR signal to find the carrier frequency and message bits. You should tap the remote's keys quickly to avoid filling the Master Controller's RAM with repetitions of the same signal. Because most remote controllers will repeat their IR signal as long as the key is held down, you should tap the Remote key and release it immediately. You should see the remote's LED blink briefly to indicate that it sent a signal. There's no point recording repetitions because the Master Controller will repeat the signal as long as you hold down the Do It key.

After the second tap, you can test the Master Controller's stored signal by aiming its IR LEDs at your VCR or TV system and pressing the Do It key. If the function works correctly, the Master Controller has a valid IR signal in RAM. You can repeat the learning process by tapping the Learn key again. Once you have a good signal stored in RAM, tap any key other than Learn or Do It to return to the

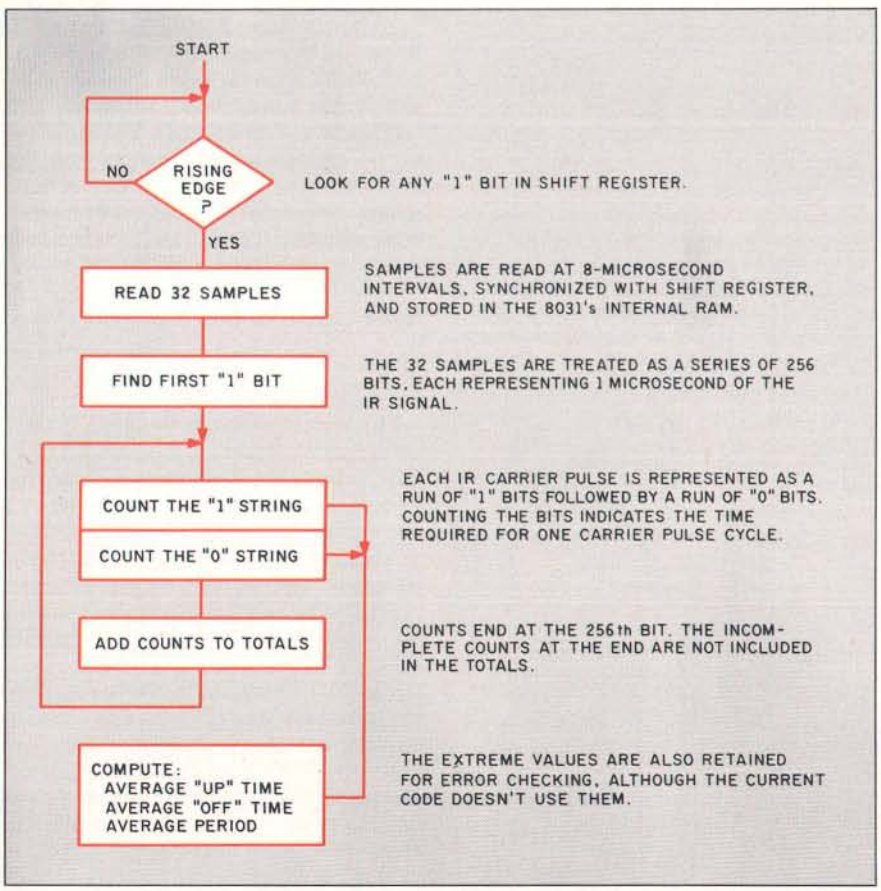


Figure 2: *Carrier-frequency measurement flowchart.*

normal display. Select the next function and repeat the learning process again. The cycle takes only a few seconds once you get the hang of it.

When all the functions are learned, reconnect the RS-232 connection to the PC and upload the menu using the MASTER program. The word "new" after each function is replaced with the length of the IR signal in bits. The Sony RM-S750 produces three repeats of 13 bits for each key press, so each function shows a length of 39. Other remotes will, of course, have different signal lengths.

Menu Modifications

At this point, you have a Master Controller menu that duplicates the functions of the RM-S750 as its first device. The MASTER program can combine the IR signals for two functions to produce the same effect as pressing two keys on the remote in sequence. This comes in handy for operations that you normally do in sequence, like turn on the power to the FM tuner and select your favorite station, for example.

To combine two IR signals, first "cut" one signal from the function menu by pressing F7. Then position the cursor over the other signal and press F10. Notice that the signal length is now the sum of the two old signals. You might want to use F9 to change the function name to reflect the new signal.

You can combine any number of function signals, with the only restriction being that the total length of the combined signals cannot exceed 1024 bits. The "cut" signal (or signals) is put at the end of the combined sequence. (Because the Master Controller uses a single carrier frequency for an entire IR signal, a combined signal may not work correctly if the signals came from different controllers.) MASTER will warn you if the carrier frequencies differ by more than about 10 percent but will allow you to shoot yourself in the foot. The Master Controller will use the first signal's carrier frequency for all the combined signals.

Some tape decks require pressing two keys (usually Record and Play) simultaneously to start recording. Generally, you can't get the same effect by pressing the Record key followed by the Play key. The reason is that the remote sends out a different message when the two keys are pressed simultaneously than it does for either of them separately. If you combine the Record and Play signals using Master, it won't work any better than the two separate keys will. You must "learn" the correct signal by pressing the two keys simultaneously. You've got to be quick on the keys to avoid filling the Master Con-

continued

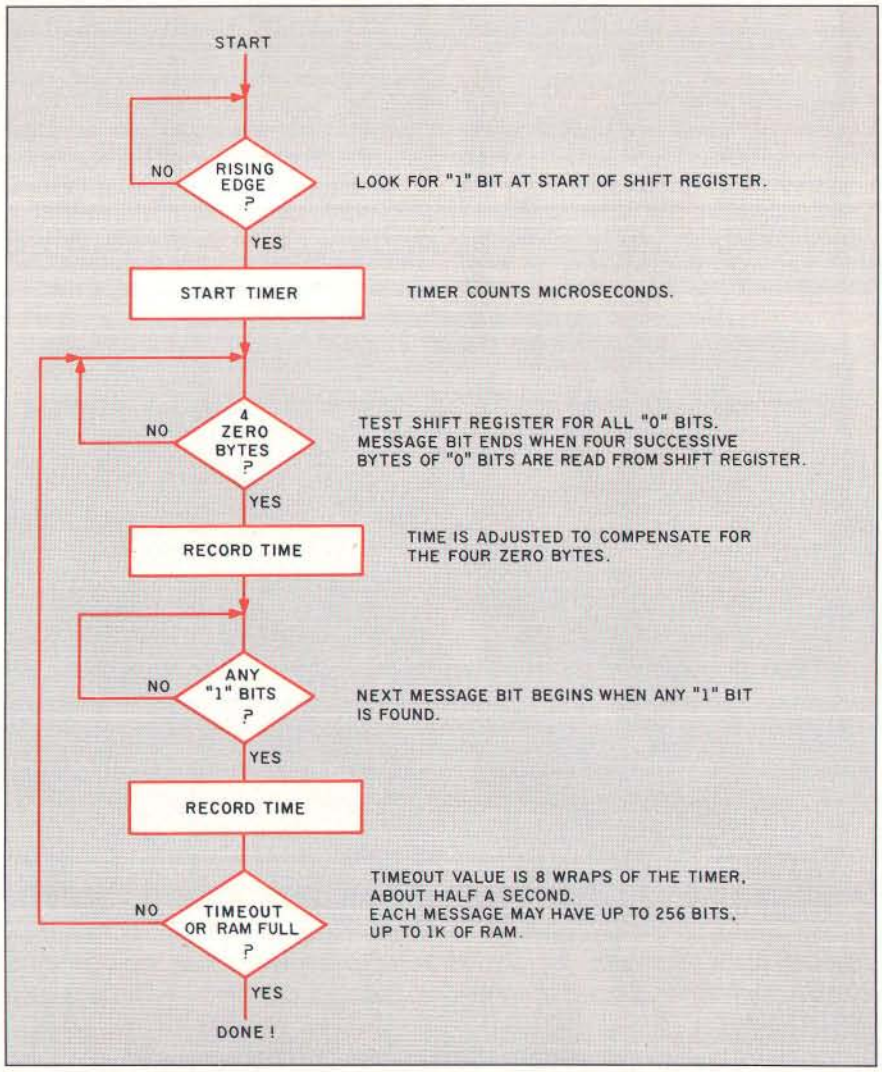


Figure 3: *Signal-capture flowchart.*



Photo 4: *The Master Controller and the IBM PC keyboard showing the MASTER program function-key template.*

troller's RAM with repetitions, though. As usual, practice makes perfect.

Conclusion

Once you've recorded the basic controller functions, you can use MASTER to combine them in wonderful ways. Although I've been calling the menu selections "devices" and "functions," you don't have to. You might wind up with a device called "Coming Home" with functions ranging from "Tired" to "Exhilarated" to turn on your system and select just the right lighting and music. Get the idea?

The Master Controller was designed and prototyped as a Circuit Cellar project. While it has some obvious and immediate consumer market potential, without a clear goal in mind it is hard to convince someone to go through the expense of manufacturing it (especially producing a custom enclosure). I have only a short time between projects, and I don't have the time to speculate on the eventual market niche or the specific configuration the Master Controller will take (Sharper Image, are you listening?). However, unless there is some way to evaluate the present device, another generation of the Master Controller will never be built.

To facilitate these evaluations, I've made a printed circuit board for the Master Controller. My intention is to populate a few more and circulate them in the proper consumer channels. While the Master Controller is not available as a kit per se, these PC boards are available if you want to build your own plague antidote.

If you don't mind a little hand-wiring, I encourage you to build the Master Controller from scratch, and I will support your efforts as usual. A hexadecimal file of the executable code for the 8031's system EPROM and the Turbo Pascal source code for the IBM PC are available for downloading from my bulletin board at (203) 871-1988. Alternatively, you can send me a preformatted PC disk with return postage, and I'll put all the files on it for you (the hexadecimal file could be used with my serial EPROM programmer, for example). Of course, this free software is limited to noncommercial personal use.

Finally, I apologize if Master Controller is someone's trademark. It seemed an obvious descriptive name for the project, but there is no way for me to know whether it has been taken without a costly trademark search. That might be necessary eventually, but it is premature at present. Perhaps I should just call it ROVER (Response to Obnoxious, Valueless, and Extraneous Remotes).

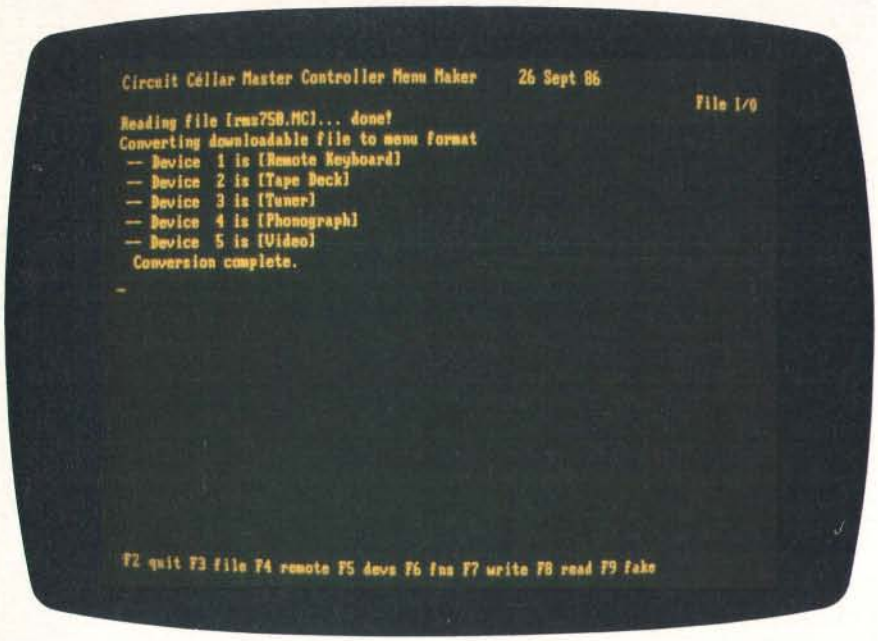


Photo 5: *MASTER program menu-maker screen with a five-device menu. Line 25 displays the function-key menu.*

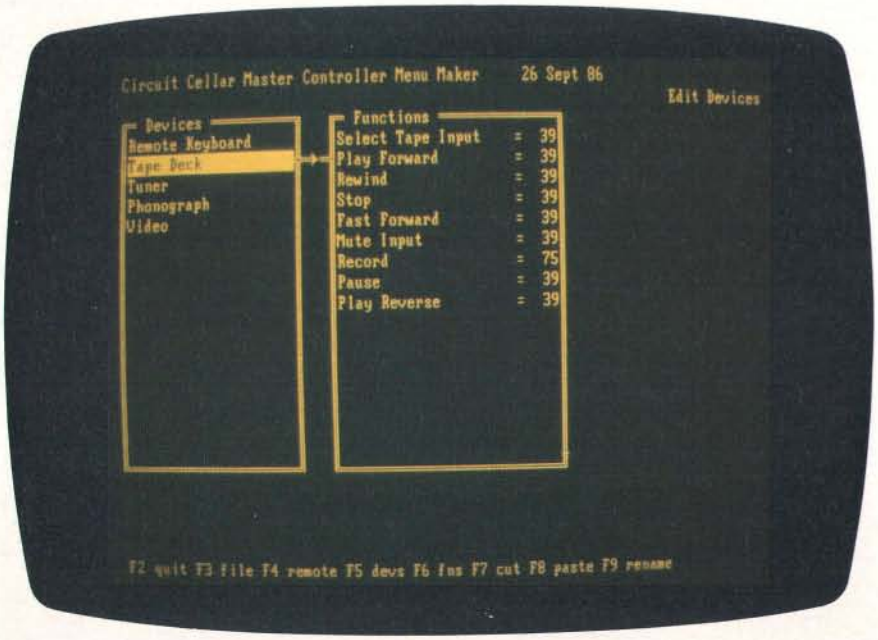


Photo 6: *MASTER program device-editor screen showing device and function menus. The Master Controller has just been trained to emulate the Sony RM-S750 controller.*

Circuit Cellar Feedback

This month's feedback begins on page 58.

Next Month

Neighborhood Strategic Defense Initiative. ■

Special thanks to Ed Nisley for his talented contributions to this project.

The 2-line by 20-character LCD is available from Jordan Technology Inc., P.O. Box 362, Lexington, MA 02173, (617) 863-8898.

The DS1210 is available from Dallas Semiconductor, 4350 Beltwood Pkwy., Dallas, TX 75244, (214) 450-0400.

Many of the individual components are available from JDR Microdevices, 1224 South Bascom Ave., San Jose, CA 95128, (800) 538-5000; Jameco, 1355 Shoreway

Table 1: *IBM PC function keys and their MASTER program functions.*

IBM PC function keys and their MASTER program functions

Rule of thumb: F2 through F6 select what you want to do
F7 through F10 actually do something
F1 does nothing
To get out of MASTER, press F2

F3 selects file I/O, then:

F7	writes the current menu to disk
F8	reads a menu file from disk
F9	creates a menu with simple names and random IR data (may be too big to fit into the remote RAM, though; this is of no use to anyone other than me)

F4 selects remote I/O, then:

F7	downloads the current menu to the remote
F8	uploads the remote's menu

F5 selects device editing, then:

F7	cuts a device and puts it on the junk list; if there was a device on the junk list, it's gone now
Ctrl-F7	deletes a device forever

F8 pastes a device from the junk list. If there's no device on the junk list, creates a new one:

F9	lets you rename a device
F6	selects function (and message) editing
F7	cuts a function and puts it on the junk list; if there was a function on the junk list, it's gone now
Ctrl-F7	deletes a function forever
Alt-F7	wipes out the IR message data for the current function
F8	pastes a function from the junk list; if there's no function on the junk list, creates a new one
Ctrl-F8	inserts a new function, leaving junk list alone
F9	lets you rename a function
F10	tacks the IR message from the junk list onto the end of the current function, leaving the junk list unchanged, so you can combine it with any number of functions

Rd., Belmont, CA 94002, (415) 592-8097; DigiKey, P.O. Box 677, Thief River Falls, MN 56701; and Advanced Computer Products Inc., 1310 East Edinger, Santa Ana, CA 92705, (714) 558-8813.

Editor's Note: Steve often refers to previous Circuit Cellar articles. Most of these past articles are available in book form from BYTE Books, McGraw-Hill Book Company, P.O. Box 400, Hightstown, NJ 08250.

Ciarcia's Circuit Cellar, Volume I covers articles in BYTE from September 1977 through November 1978. *Volume II* covers December 1978 through June 1980. *Volume III* covers July 1980 through December 1981. *Volume IV* covers January 1982 through June 1983. *Volume V* covers July 1983 through December 1984.

The following is available from

CCI
P.O. Box 428
Vernon, CT 06066
(203) 875-2751

Master Controller experimenter's kit that includes printed circuit board with ROM-resident software on a 2764 EPROM, detailed parts list, and IBM PC programs on disk.
Order MC Exp. Kit $54

All payments should be made in U.S. dollars by check, money order, MasterCard, or Visa. Surface delivery (U.S. and Canada only): add $3 for U.S., $6 for Canada. For delivery to Europe via U.S. airmail, add $10. Three-day air freight delivery: add $8 for U.S. (UPS Blue), $25 for Canada (Purolator overnight), $45 for Europe (Federal Express), or $60 (Federal Express) for Asia and elsewhere in the world. Shipping costs are the same for one or two units.

There is an on-line Circuit Cellar bulletin board system that supports past and present projects. You are invited to call and exchange ideas and comments with other Circuit Cellar supporters. The 300/1200/2400-bps BBS is on-line 24 hours a day at (203) 871-1988.

To be included on the Circuit Cellar mailing list and receive periodic project updates and support materials, please circle 100 on the Reader Service inquiry card at the back of the magazine.

Inquiry 251

Try It.
Then Buy It.
PC-Write.™

A fast, full-featured word processing package for only **$16.** Complete. You get a quick reference guide and tutorial on disk, 45 help screens, choice of function keys or menus, mail merge, spelling check, advanced formatting, and support for over 350 printers including the HP LaserJet Plus.

Try *PC-Write* for only **$16.**
Then register for **$89** to get:
- o Latest diskette pair
- o Hardbound manual
- o Two updates
- o Phone support
- o Newsletter

Plus, your registration fee supports our development of new *PC-Write* features.

Shareware means you can freely copy and share the *PC-Write* diskette.

Register only if you decide to use it. No risk!



Byte Magazine Mar 1987
Version 2.7 Features
50,000 word *Spelling Checker.* Clip text from other screens. supports Laserjet+ fonts. Site Licenses now available to companies and schools.
(This ad was created with PC-Write)

Order *PC-Write* Today.
Satisfaction Guaranteed.

Quicksoft™
(206) 282-0452
219 First N. #224y
Seattle, WA 98109
VISA MasterCard

A SIMPLE VAL



Why spend good money for a good printer when you could spend less money for a great one?

Introducing the ALPS P2400C Dot Matrix Printer. It does just about everything better than the more expensive model on the left.

It works faster, for instance. It prints drafts at 360 cps, memos at 180 cps and letter quality text at 120 cps. And it handles everything from spreadsheets to seven-color graphics.



The P2400C prints everything from letter quality documents to high resolution graphics in seven colors.

It works harder. It has a built-in push/pull tractor feed. A print buffer expandable to 256K. Snap in/out 24- or 18-pin print heads. Multiple font cartridges. And, of course, full compatibility with the most popular PCs and software.

E JUDGEMENT.



It works easier, too. You simply push buttons on the front panel to do everything. Change type styles and print modes, load paper, even override your software. All without lengthy software commands, or DIP switches.

What's more, the P2400C works longer hours. Give it normal care and it'll give you over five years of trouble-free performance. Even when it's working for an office full of busy PCs.

Now if you still think the best printer is the most expensive one, here's what to do.

Call us at **(800) 828-ALPS.** In California, (800) 257-7872. And we'll send you more information or arrange a free demo.

Then you can be the judge.

ALPS
AMERICA

IT'S TIME YOU SAW THE ALPS.

Inquiry 12 for End-Users. Inquiry 13 for DEALERS ONLY.

P2400C is a trademark of ALPS Electric Co., Ltd. ©1986 ALPS America.

Introducing OptiLab™:

The Complete Microprocessor Development Toolbox.

You need the right tools to speed completion of your project and improve its quality.

That's why we created the OptiLab toolbox. The tools you want for beginning-to-end development and optimization of microprocessor code. OptiLab's fully-integrated, PC-based system lets you debug, analyze, modify, optimize, and test code in a seamlessly integrated environment. You can add your own cross-assembler, too.

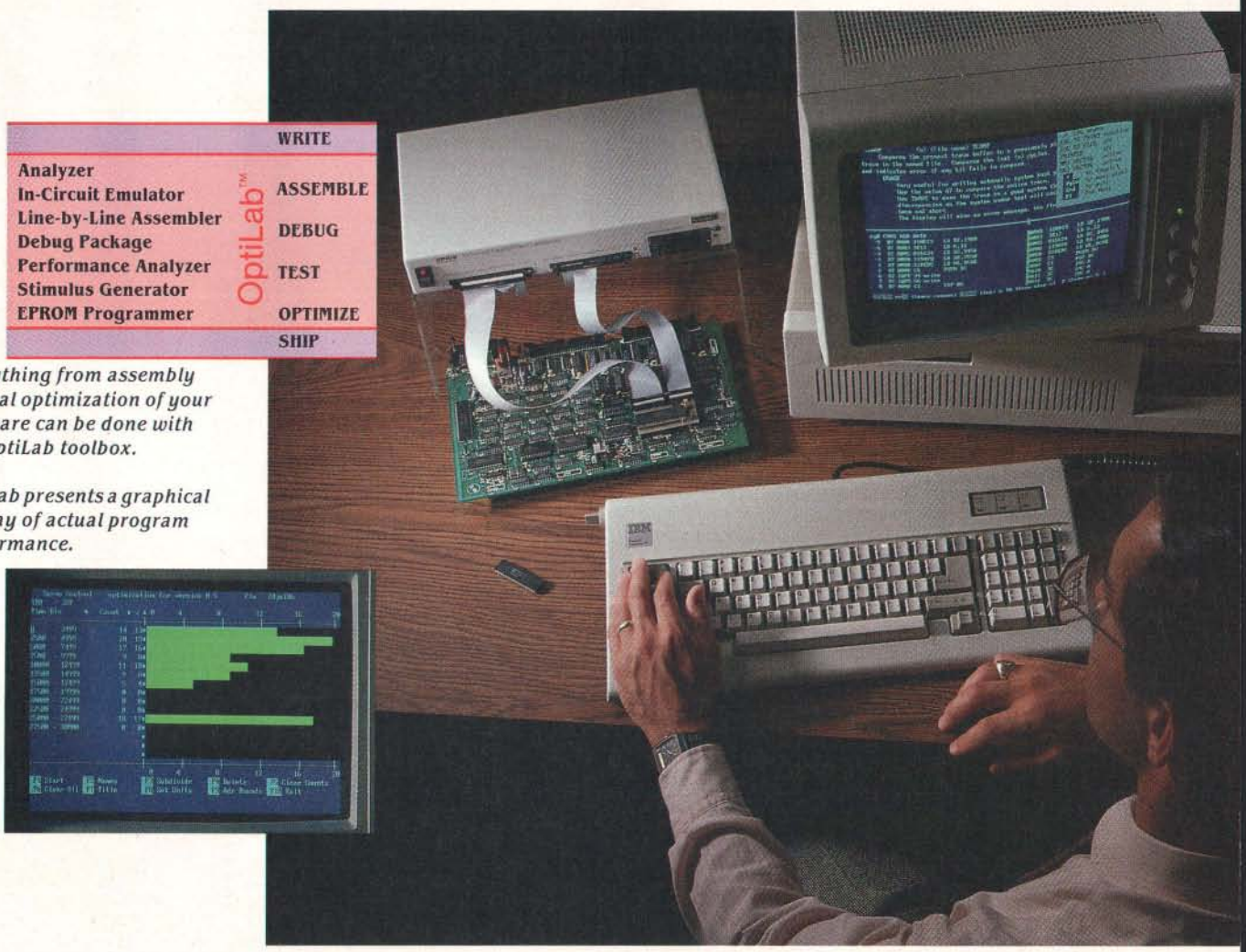
The star of the OptiLab is Program Performance Analysis that helps you uncover invisible bugs, eliminate unneeded code, and cure program inefficiencies. OptiLab runs in real-time, is non-intrusive, and gives you outstanding performance at a remarkably low price.

There's more. OptiLab's 48-channel analyzer lets you track bus state activity and trap bugs fast. Monitor your software as it executes in real time with the full-featured 8/16-bit In-Circuit Emulator. Send test patterns with the Input Stimulus Generator and observe their effects. With the built-in EPROM Programmer, you can program devices without leaving OptiLab.

Orion offers you ready support for more than 150 different microprocessors. MicroTargets™ allow you to run and test your software even before you have working hardware. And our crack team of Applications Engineers is standing by if you need assistance.

But here's the real news. OptiLab is priced under $7,000. Or, you can start with a basic Orion system for as little as $2,995 and add capabilities as you need them.

Call now for complete information on OptiLab or other Orion microprocessor development tools. All Orion products are sold with a 15-day money-back guarantee.



Everything from assembly to final optimization of your software can be done with the OptiLab toolbox.

OptiLab presents a graphical display of actual program performance.

ORION INSTRUMENTS, INC.

Call Toll Free: 1-800-245-8500
In California: (415) 361-8883

Orion Instruments, Inc., 702 Marshall Street, Redwood City, California 94063, U.S.A. Telex: 530942

Inquiry 214

Brian Wichmann and David Hill

Building a Random-Number Generator

A Pascal routine for very-long-cycle random-number sequences

Anyone who considers arithmetical methods of producing random digits is, of course, in a state of sin.

—John von Neumann (1951)

John von Neumann's classic comment presents the paradox of random-number generation: The random-number sequences that computers produce are not truly random at all, since true randomness depends upon having a random process available, such as tossing a coin. Because such a process is not available within a computer, we use a pseudorandom process to produce sequences of numbers that appear to be random and mimic well the behavior that we expect of true random sequences.

Such a process is not only easier to use than a truly random process, but it also produces numbers that can be repeated if necessary. In testing a program, for example, it can be troublesome if every run is necessarily different because of different random numbers. Pseudorandomness lets us use the same numbers over and over again for testing but use different ones for each production run.

We can test whether a particular pseudorandom method is adequate or not for its purpose by using conventional methods. Such testing is not easy, as we shall see later.

Many generators use a simple multiplicative rule to generate the next number based on a fixed prime number and a multiplier. For instance, if the prime number were 30,269 and the multiplier 171, you would have $x_{i+1} = (171 * x_i) \bmod 30{,}269$ (i.e., multiply by 171, divide by 30,269, then take the remainder).

The sequence of values for x_i goes through all the values between 1 and 30,268 in a shuffled order before repeating itself. This is a consequence of using a prime and the choice of the multiplier.

Some microcomputers use such a simple method directly and, as a result, do not produce a sequence that will pass the more severe statistical tests. A poor generator may lead to the wrong conclusions as a result of its use. If you are a cautious user, you will not depend upon the built-in random number but will incorporate one into your program that you know has been well tested.

The Ideal Generator

What properties should a random-number generator have? First, it should have repeatability, so that when you move a program from one machine to another, you can guarantee exactly the same results. Second, it should be efficient; otherwise, your program may run too slowly. Third, the algorithm should be written in a high-level language so that you can port the code from one machine to another without difficulty. The algorithm presented here meets all these criteria.

The Portable Generator

The solution depends upon two techniques. First, consider the problem of using a high-level language. The simple generator given above can be written in Pascal as `x := (171 * x) mod 30269`. In practice this coding will not work adequately on all machines. The values of x are restricted to the range 1 through 30,268 and therefore will fit into a 16-bit word. This is not true for $171*x$, so the expression will malfunction on many machines. You could perform the above calculation "double length," but this either requires machine code or is very expensive in both time and space. If we write x in the form $177*r+s$ where $0 \le s \le 176$, then $171*x = 171 * s + 171 * 177 * r = 171 * s + 30{,}267 * r = 171 * s + 30{,}269 * r - 2 * r$. Since $30{,}269 * r \bmod 30{,}269$ is 0, $(171*x) \bmod 30{,}269 = (171*s-2*r) \bmod 30{,}269$. Therefore, the Pascal statement above can now be written as `x := 171 * (x mod 177) - 2 * (x div 177);`. There is one problem, however. The Pascal program can return a negative number if we do not add the following:

```
if x < 0 then
  x := x + 30269;
```

We now have a mechanism for making a simple generator for a 16-bit machine. We choose a prime just slightly less then 32,768 and then a multiplier (around the square root of the prime). By using the above coding trick, the problem of overflow can be eliminated with the equivalent of five or six additional (machine) instructions.

But such a simple generator on its own is inadequate. It will repeat itself too soon, and its statistical properties are not near enough to those of randomness. To improve it, we need a second technique that combines two or more generators to make a new generator that is statistically superior to any of its components. To understand this method, consider the random numbers $x1$ and $x2$ in the range $0<x<1$. We will call the fractional part

continued

Brian Wichmann is a consultant at the United Kingdom National Physical Laboratory (Teddington, Middlesex TW11 0LW, U.K.). He is the coauthor of Modified Algol 60 and was a member of the Ada language design team.

Dr. David Hill is a statistician at the Clinical Research Centre (Watford Rd., Harrow, Middlesex HA1 3UJ, U.K.). He is a former Honorary Secretary of the Royal Statistical Society.

Testing a generator is not straightforward, since the nature of randomness is that anything can happen and sometimes will.

of $x1+x2$ the combination of $x1+x2$. It is clear that if $x1$ and $x2$ are independent and uniformly distributed, then the combination of $x1+x2$ is also uniformly distributed over the same range of values. Moreover, if each of $x1$ and $x2$ is nearly random, the combination of $x1+x2$ will be much more nearly so than either of them individually.

The method of constructing our ideal generator is now clear. We take a few simple generators using the first technique until we obtain a combination that produces satisfactory statistical results. In fact, three generators had to be combined since combining only two did not produce totally satisfactory results. We have extracted our completed generator from the Pascal program, and it is shown as listing 1. [Editor's note: *Source code for a standalone Microsoft BASIC version of the Pascal routine, written by John Nash, is available on disk, in print, and on BIX. See the insert card following page 352 for details. The listing is also available on BYTEnet; see page 4.*]

Combining the generators works correctly only if they are independent. In fact, they cannot be completely independent since, if the three primes are p, q, and r, the cycle lengths are $p-1$, $q-1$, and $r-1$, and these necessarily have 2 as a common factor. They can, however, be made nearly independent enough for practical purposes if we make sure that they have no other common factor. This means that the cycle length of the combined generator is $(p-1)(q-1)(r-1)/4$, which in our case is about 6.95E+12. This means that if 1000 numbers were calculated every second, it would not repeat itself for over 220 years. Consequently, we have tested only a small part of the sequence for statistical soundness. However, the method of combining the generators results in theoretical grounds for expecting good results, so we are prepared to extrapolate our experience and infer that the sequence is satisfactory throughout.

Listing 1: *A Pascal fragment showing the random-number generator routine.*

```
program . . .
  var
  x, y, z: integer; {global seeds}
    . . .
function random: real;
  var
    temp: real;
  begin
  {first generator}
  x := 171 * (x mod 177) - 2 * (x div 177);
  if x < 0 then
    x := x + 30269;
  {second generator}
  y := 172 * (y mod 176) - 35* (y div 176);
  if y < 0 then
    y := y + 30307;
  {third generator}
  z := 170 * (z mod 178) -63 * (z div 178);
  if z < 0 then
    z := z + 30323;
  {combine to give function value}
  temp := x/30269.0 + y/30307.0 + z/30323.0;
  random := temp - trunc(temp)
  end;
  . . .
  begin
  {Initialize seeds. For production runs, different values
  [between 1 and 30,000] should be used each time, preferably by
  some automatic method such as from date and time readings if
  available.}
    x := 1; y := 10000; z := 3000;
    . . .
    end.
```

The Tests

Testing a generator is not a straightforward problem, since the nature of randomness is that anything can happen and sometimes will. If a generator always passes all its tests, it is a failure: It ought to fail on a due proportion of occasions.

The tests applied to the generator, along with results, are described in a National Physical Laboratory report (see reference 1). First, we tried a serial test on the generator's output. We know that a single-component generator would fail this test, since any very small value is always followed by the same value multiplied by the multiplier.

The second test consisted of simulated poker hands. Five calls of the generator were used to construct a hand. The number of hands with all different cards, one pair, two pairs, and so on, were accumulated.

The third test was for runs up and down. The tests for runs up are not independent of tests for runs down, so they are done separately. The first to the fifth digits were tested in the way specified by Grafton (see reference 2).

In general, the generator passed with flying colors. But that, of course, includes failing in approximately the right proportion of cases. Well, not exactly the right proportion, for that would be too good to be true, which would again be a failure to behave randomly.

Conclusion

We have explained the algorithm we developed but not the many blind alleys we encountered. Our initial requirement was for a portable generator to be included in a set of Pascal test programs (see reference 3). Initially, we were unsure that the objectives could be met at all. Retesting the algorithm whenever making even the smallest change made the work tedious. In all, the project took about three months of effort, a lot for 16 lines of code but well worth it. ■

REFERENCES

1. Wichmann, B. A., and I. D. Hill. "A Pseudo-Random Number Generator." NPL report, DITC, 6/82.
2. Grafton, R. G. T. "Algorithm AS 157: The Run-up and Run-down Tests." *Applied Statistics*, vol. 30, pages 81–85.
3. Wichmann, B. A., and Z. J. Ciechanowicz, editors. *Pascal Compiler Validation*. New York: Wiley-Interscience, 1983.

Brian Edginton

Installing Memory-Resident Programs with C

Using C programs to extend DOS



This project started as a challenge to make a friend's calculator program load and remain resident in memory on an IBM PC. Techniques for making an assembly language program stay resident have been presented in many articles and books, but writing the tools to make a C program resident was a new adventure. I developed all the examples in this article with Lattice's C Compiler 3.0 and Microsoft's Macro Assembler 4.0. I've tried to make the code as portable as possible, but some modification will be necessary for different compilers and languages. In the listings, I've noted any compiler-dependent variables. [Editor's note: *William J. Claff's article, "Writing Assembly Language Interrupt Routines," in BYTE's Fall 1986 special issue "Inside the IBM PCs" contains additional information on the topic of DOS extension via memory-resident programs.*]

What Is a Resident Program?

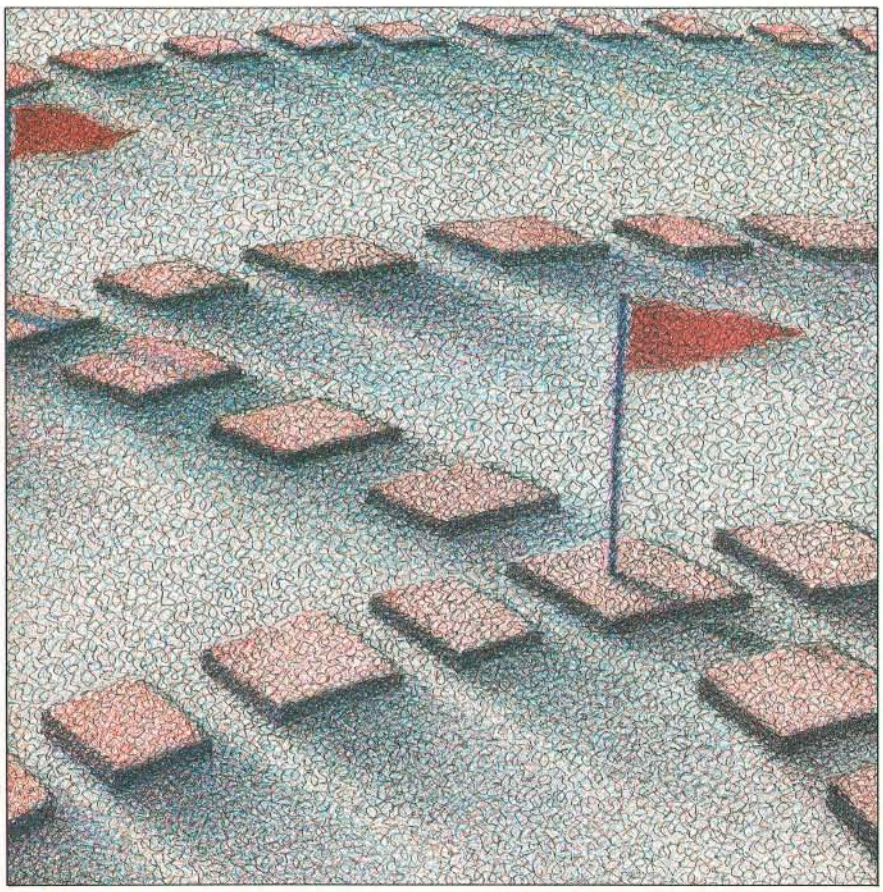
DOS uses a set of pointers called *storage blocks* to keep track of allocated and unallocated memory in the system. For each loaded program, these pointers indicate the address of its PSP (program segment prefix) and the program's length in segments. Also, a flag indicates whether or not the memory pointed to by the storage block is allocated. When a program module is loaded and executes an INT 27H (terminate but stay resident) or DOS function 31H (keep process), COMMAND.COM makes sure that this program becomes a part of DOS. This means that the storage block, PSP, and program module remain in memory and are not reallocated.

The principles behind making a program resident are straightforward: Find the length of the program, shove it into a register, and call a documented function. DOS function 31H requests that the program size in paragraphs is to be placed in the DX register and the return code, if any, in AL.

As shown in listing 1, it is a simple matter to make a program resident. If you have a utility like Norton's SI or SMAP, you can verify that the program is indeed resident by looking at the address location of the next program to be loaded. You can also examine the amount of free memory displayed by the CHKDSK utility before and after running the program.

Usually, you want to write a program that does more than just take up memory.

continued



Brian Edginton is the president of Edginton and Associates, where he is a programming consultant specializing in UNIX, C, networks, and Prolog. He can be contacted at 551 Ramona Ave., Salt Lake City, UT 84105.

ILLUSTRATION BY DAVE RIDLEY

Listing 1: *A simple terminate-but-stay-resident C program.*

```
#include <dos.h>
main()
{
extern int _TSIZE;      /* size of program in paragraphs */
   union REGSS input,output;

       input.x.ax = 0x3112;     /* 31 -> AH and Return Code */
       input.x.dx = _TSIZE;     /* program size (Lattice)   */
       intdoss(&input,&output); /* function call 31  */
        }
```

Listing 2: *A more involved version of listing 1. This program indicates its presence with a "signature" written to the* INT 67H *vector. In this way, it can determine if it has already been installed.*

```
#include <stdio.h>
#include <dos.h>

main()
{
        install();

        cpush();
        printf("Hello world\n");
        cpop();

}


install()
{
        extern int _TSIZE;              /* size of program in paragraphs (Lattice) */
        extern struct storage;
        union REGSS input,output;
        struct SREGS segregs;
        short nu_entry,nu_cs;

        /* test for signature of installation.  In this example we will
         * put the signature in at the int67 vector and test for it there.
         */
        input.x.ax = 0x3567;
        intdoss(&input,&output);
        if(output.x.es == 0xffff && output.x.bx == 0xffff){
                printf("This test already installed...\n");
                exit(0);
        }

        nu_entry = (short)main + 6;
        printf("%x - ax\n",storage.rax);

        segread(&segregs);      /* get current registers */
        nu_cs = segregs.cs;

        input.x.ax = 0x3560;
        intdoss(&input,&output);
        printf("ES:BX from int60 is %x:%x\n",output.x.es,output.x.bx);

        input.x.ax = 0x2560;    /* set vector register */
        input.x.dx = nu_entry;  /* address of new vector */
        input.x.ds = nu_cs;     /* current cs */
        intdoss(&input,&output);

        input.x.ax = 0x3560;
        intdoss(&input,&output);
        printf("ES:BX from int 60 is %x:%x\n",output.x.es,output.x.bx);
```

continued

```
        input.x.ax = 0x2567;    /* sign your work */
        input.x.dx = 0xffff;
        input.x.ds = 0xffff;
        intdoss(&input,&output);

        input.x.ax = 0x3100;
        input.x.dx = _TSIZE;
        intdoss(&input,&output);

        exit(0);
}
```

You want a program that responds to a system interrupt and supplies you with some sort of information. It should also be well behaved and operate within the constraints of DOS.

My design of this system had several goals: modular design for universal application, optimum memory usage, and correct processing of interrupts.

Modular design means that I can, with minor revisions, make this program load any module that meets the requirements for a resident interrupt-processing program. To determine these requirements, I made a careful analysis of what my compiler did to a program and what my linker did to the object modules supplied to it. If you are using some other compiler and/or linker, these requirements might be different. Listing 2 is an example of a completed sample system. Since we have little control right now over anything that happens above main( ), we'll start there and analyze what happens. Refer to listing 3, which is a disassembled version of the top-level code in listing 2.

We'll create the routines cpush( ) and cpop( ) later to help get into and return from the interrupts. Since main( ) is really just another function called by the compiler's entry module, which is what is loaded by EXEC, the BP register is saved and then set to the new SP. This is a requirement of any functions called from another routine that might pass any information on the stack; it lets the functions reference that information on the stack via the BP register while still letting new data be pushed on the stack as required.

You should design entry into a resident program so that any parameters are passed in the DOS communications area or in registers, and not on the stack. Once a program module is installed in memory, you want to ignore the call to install( ). Although this uses 6 bytes of memory, passing the address of the call to cpush( ) to the interrupt vector is the most efficient way to install the module. All function names are made common in a C compiler, so you can create the new vector IP by doing

```
nu__entry = (short)main + 6;
```

Listing 3: *A disassembled form of the top-level code in listing 2.*

```
main()
{
0000                                PUSH  BP
0001                                MOV   BP,SP
0003  install();                    CALL  install
0006  cpush();                      CALL  cpush
      printf("Hello world\n");
0012  cpop();                       CALL  cpop
0015                                POP   BP
0016                                RET
}
```

Casting main to a short keeps it consistent with the way the rest of the register structures are typed. The nu__entry now points to the desired entry point in the program. Since you did not need to use the compiler-generated PUSH BP and you are returning from an interrupt, you can ignore the POP BP and the RET that the compiler put at the end of main.

The install( ) function is straightforward. In this example, I borrowed an unused function call's vector to leave a signature or message to the calling program already installed. To increase the safety of this routine, you could first verify that the interrupt vector is filled with zeros. If it is not, check another vector until you find one with no vector already installed. Alternatively, you could indicate that the module is already installed by setting a flag in memory, but you would have to choose a byte that you are certain would not be used by some other routine.

Another method for routines that handle passed values (i.e., video calls, put and get char, and string calls) would be to detect a certain value and return an "already installed" message to the installation program. Listing 4 shows a segment of code that you could modify to perform this method of signature detection.

Next, you must decide how to best utilize the memory taken up by the program. Since I used function call 31H instead of INT 21H to terminate the program, loaded programs can exceed the 64K-byte limit imposed by the latter. I can use .EXE programs with stack and data segments defined—not just .COM programs. A .COM program uses as much memory as the machine has left when it is loaded; if the program is going to stay resident, it has to return its unused memory to the system.

I release the memory that contains the program's copy of the environment using routine d__env( ). On entry, the ES and DS (and SS and CS for a .COM program) segment registers point to the PSP at offset 0. Listing 5 shows the code for d__env( ). I load ES with the address of the segment containing the copy of the environment and call DOS function 49H (free allocated memory).

If the program is a .COM file, you can reduce its size using the routine shrink( ) (see listing 6). This function sets the memory used by a program to the size of the program module in paragraphs. If you write .COM programs, be sure that you allocate stack area before calling this function. If you use shrink( ), you should call it before calling d__env( ) so that the ES register contains the correct information for the call to function 4AH (modify allocated memory blocks). You could modify the code to perform both operations with one call; this would increase speed and reduce program size.

The last area I will cover concerning memory management is heavily influenced by my familiarity with the Lattice compiler. This compiler uses a file to set up the segment registers, handle stack and memory allocations, report errors like

continued

MicroCom Systems
OUTSTANDING SOFTWARE
For IBM PC's and Compatibles

$3.50 PER DISK
SMALL QUANTITIES

$3.00 PER DISK
FOR TEN OR MORE

$1 OFF 5 DISKS OR MORE WITH THIS COUPON

☐ **CAD 1** — Altamira, a four color object oriented drawing program. Color gr. req'd.
☐ **COMM 3** — Compression/decompression and archival utilities for telecommunications.
[2] **DATABASE 1,2** — (2 disks) PC-File III, Version 4, a user friendly database system.
☐ **DATABASE 3** — The pBASE relational database manager with query language.
☐ **EDUCATION 1** — Interactive DOS tutorial for new PC users. Makes learning DOS painless.
☐ **GAMES 1** — Chess, 3-D Packman, Kong, Spacewar, JanitJoe, and more. Color gr. req'd.
☐ **GAMES 2** — Qubert, Pango, Centipede, Monopoly, Zoarre, and more. Color gr. req'd.
☐ **GAMES 3** — Blackjack (you set rules), Arm Chair QB, and Empire (war game).
☐ **GAMES 4** — Castle, Star Trek, and the original Collossal Caves ADVENTURE.
☐ **GAMES 5** — The HACK adventure game from the universities. Like Rogue.
☐ **GAMES 6** — Pinball, Othello, Dragons, Sopwith (fly one), and more. Color gr. req'd.
☐ **GAMES 7** — Round42 (16 color graphics), Backgammon and more. Color gr. req'd.
☐ **LANGUAGE 2** — The renowned SMALL-C compiler and a C interpreter!
☐ **LANGUAGE 5** — Turbo Pascal interactive debugger, pop-up help, formatters, etc.
☐ **LANGUAGE 7** — Pascal interpreter/compiler. Great for learning Pascal!
☐ **MUSIC 1** — Many clever tunes, and an excellent color graphics music editor.
☐ **ORGANIZER 1** — DeskMate, a Sidekick clone, and the Judy calendar program.
☐ **ORGANIZER 3** — The PC-Outline windowing outline editor/thought organizer.
☐ **PICTURES 2** — High res digitized graphics pictures. Color graphics required.
☐ **PINUP 2** — Provocative high res digitized graphics pinups. Color graphics required.
☐ **PRINTER 1** — Font and sideways utilities, spoolers, banner makers, and more.
☐ **UTILITIES 1** — A collection of invaluable general purpose DOS utilities. A must!
☐ **UTILITIES 2** — More invaluable DOS utilities. Too many to list here!
☐ **UTILITIES 3** — A comprehensive set of debugging and diagnostic utilities.
☐ **WORD 1** — PC Write 2.6, a powerful and complete word processing system.
☐ **WORD 3** — The PC Style writing analysis program and FOG complexity index finder.

— NEW RELEASES —

☐ **BUSINESS 1** — EZ-Forms business form generation, completion, and printing program.
☐ **CAD 2** — An advanced 2D/3D drafting program. 640k required. Color gr. req'd.
[2] **COMM 1,2** — (2 disks) Version 2.2 of the ever-popular QMODEM communications prog.
[4] **COMM 4,5,6,7** — (4 disks) Latest RBBS Bulletin Board System 14.1D.
[2] **COMM 8,9** — (2 disks) PROCOMM 2.4, an exc. modem program with terminal emulation.
[2] **INFO 1,2** — (2 disks) Cooking recipes database with keyword/ingredient retrieval prog.
☐ **LANGUAGE 1** — PDProlog 1.9v, 5th generation language for artificial intelligence.
☐ **LANGUAGE 3** — A86, a full featured 8086/8088 macro assembler.
☐ **LANGUAGE 8** — Xlisp 1.7, the standard for Artificial Intelligence programming languages.
☐ **LANGUAGE 9** — The ICON string and structure oriented programming language.
[2] **MUSIC 2,3** — (2 disks) PianoMan Ver 3.0 polyphonic music recording & playback prog.
☐ **WORD 4** — The Speller spell-checking program. Includes customizable dictionary.

Catalog available, add $2. 3.5" format add $1/disk.

Cost of Items _____
CA Res 7% Tax _____
Ship/Handling _____ Domestic $1./Foreign $5.
Total Enclosed _____

VISA MasterCard
MicroCom Systems
(415) 325-6500
P.O. Box 51657, Palo Alto, CA 94303

BY-387

Listing 4: *A method of signature checking to determine whether a routine is already installed.*

```
calling(program)
{
        union REGSS in,out;

        ......
        in.x.ax = 0x0088;
        intdoss(int_num,&in,&out);
        ........
}

int_num

        switch((int)in.x.ax){
        case 0x88:
                return installed
        case 0xXX
                do something else
```

Listing 5: *Source code for the* d_env( ) *routine.*

```
; d_env is used to deallocate the memory used
; by a program's copy of the environment.

        TITLE     ENVIRONMENT DEALLOCATION
        SUBTTL    Copyright 1986 Brian Edginton
        NAME      D_ENV
        INCLUDE   DOS.MAC

        PSEG
        PUBLIC  D_ENV
        IF      LPROG
D_ENV   PROC    FAR
        ELSE
D_ENV   PROC    NEAR
        ENDIF

        PUSH    BP
        MOV     BP,SP
        MOV     ES,[DI+2CH]
        MOV     AX,4900H
        INT     21H
        POP     BP
        RET
D_ENV   ENDP
        ENDPS
        END
```

Listing 6: *Source code for the* shrink( ) *routine.*

```
        TITLE     PROGRAM SHRINKER
        SUBTTL    Copyright 1986 Brian Edginton
        NAME      SHRINK
        INCLUDE   DOS.MAC

        PSEG
        PUBLIC  SHRINK
        IF      LPROG
SHRINK  PROC    FAR
        ELSE
SHRINK  PROC    NEAR
        ENDIF

        PUSH    BP
        MOV     BP,SP
```

continued

$2000?
That's Too Darned High!

Why should a CAD package cost more than a Word Processor? It shouldn't! Lots of people ask how we can offer a CAD system as good as ProDesign II at a price as low as $299. It's easy. A PC Software Package does not cost $2000 to manufacture. It doesn't even cost $200. It makes us ask the questions "Why do comparable CAD packages cost $2000 and more? What makes a CAD package cost more than a Word Processor?"

ProDesign II doesn't. ProDesign II is the complete CAD package you get for $299. With ProDesign II, you get such advanced features as Auto Dimensioning, Area Fill (Hatching), Fillets, Mirroring, Isometrics, Curve Fitting, Object Snap, Attributes, Drawing Merge, Area Calculation, Parallel Lines, Parallel Curves, Tangents, Perpendiculars, and many many more. Features once available only for $2000 or more. Features you get at no extra charge with ProDesign II.

But there is another, very important reason you should get ProDesign II. ProDesign II is very unique among CAD packages. It is easy to learn and use. When we call ProDesign II "The Easy to Use CAD System", we're not joking. You will be productive with ProDesign II in an hour or two instead of a week or two. In fact, we are confident that ProDesign II is without a doubt the easiest CAD system in the world to learn and use!

What else does ProDesign II offer? Compatibility. Compatibility with over 150 printers. Compatibility with over 80 plotters. Compatibility with most graphics adapters, digitizing tablets, and mice. Compatibility with most display adapters. Compatibility with any software that can produce HP plotter commands. Compatibility with mainframe CAD systems (IGES). All at no extra charge! (You can also get an AutoCAD Interchange Utility for $99 that converts drawings to or from the AutoCAD format.)

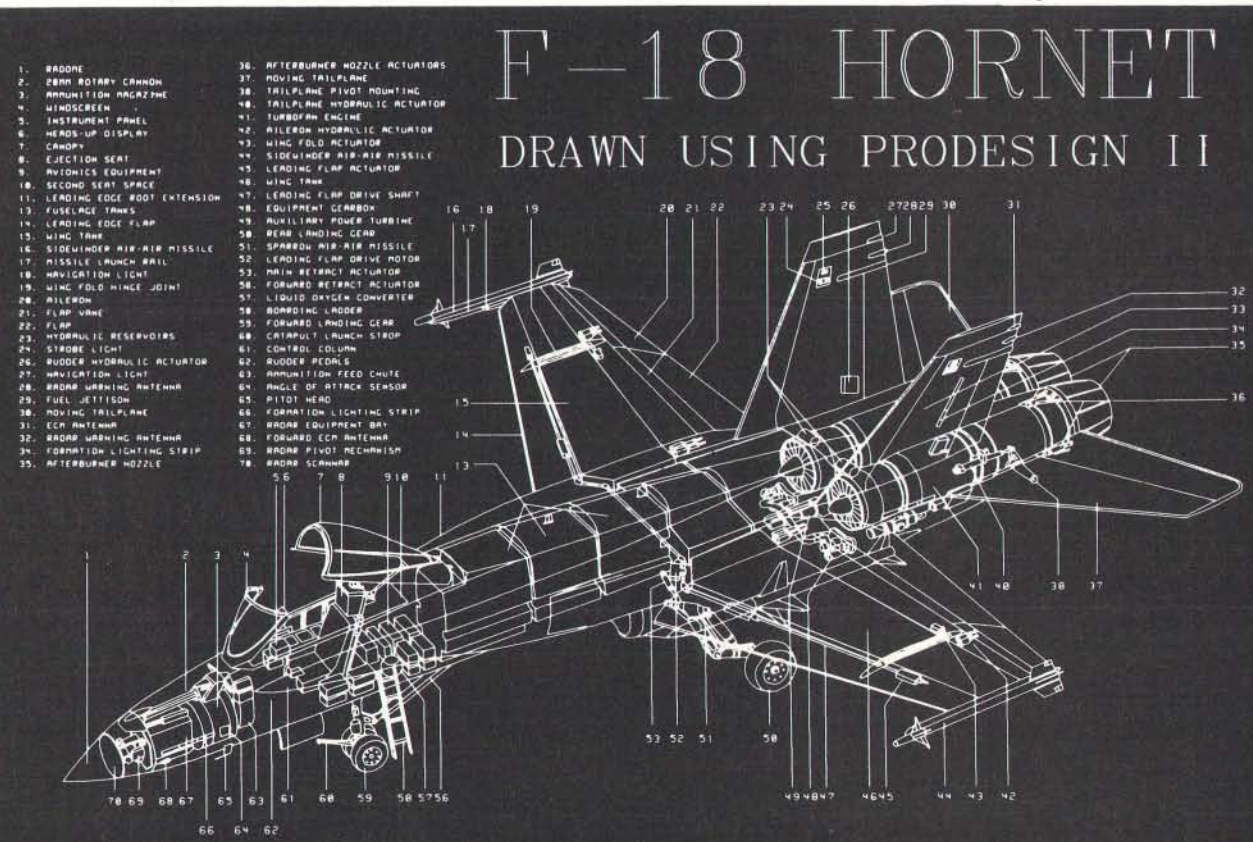
What additional hardware do you need? None! An IBM PC compatible and 512K RAM is all you need. ProDesign II produces high resolution drawings on your dot matrix printer - better than .005" resolution on a IBM/Epson compatible printer. And you don't have to get a mouse or digitizing tablet. ProDesign II is designed for easy and efficient keyboard use. You won't even need a math coprocessor, although it is supported. From a small drawing on a dot matrix printer to an E-Size drawing on a large plotter, ProDesign II is the one to use!

ProDesign II — Affordable, Compatible, and Usable!

Where do you get it? See your local dealer or contact:

American Small Business Computers
118 South Mill Street
Pryor, OK 74361 Inquiry 20
918/825-4844 **TELEX 9102400302**

PRODESIGN II — ONLY $299!



```
        MOV     BX, ????  ; PROGRAM SIZE + ANY
                          ; STACK YOU NEED.
        MOV     AX,0X4A00 ; CALL MODIFY
                          ; ALLOCATED MEMORY
        INT     21H       ; BLOCKS ROUTINE.
        POP     BP
        RET
SHRINK  ENDP
        ENDPS
        END
```

My main concern is with saving registers because of the amount of calls normally found in a C program.

Listing 7: *Source code for the* cpush( ) *and* cpop( ) *routines used in listing 2.*

```
; These routines emulate a push-all of the
; registers and segregs before an interrupt
; is executed, and then pop them in the
; same order.
; Note: cpopt is used for testing so we use
; a ret instead of an iret.


        TITLE   REGISTER MANIPULATION ROUTINES
        SUBTTL  Copyright 1986 by Brian Edginton
        NAME    STORE
        INCLUDE DOS.MAC

        DSEG
; Register and stack storage structure follows.
S       STRUC
        RAX     DW      ?
        RBX     DW      ?
        RCX     DW      ?
        RDX     DW      ?
        RSI     DW      ?
        RDI     DW      ?
        RDS     DW      ?
        RCS     DW      ?
        RSS     DW      ?
        RES     DW      ?
        RIP     DW      ?  ; Storage for 2 words
        RBP     DW      ?  ; pushed for iret
        RFL     DW      ?  ; and flags.
        RRT     DW      ?  ; Return address
                           ; pushed for call.
S       ENDS
STORAGE S       <0,0,0,0,0,0,0,0,0,0,0,0>
        ENDDS


        PSEG

        ;  name - cpush()
        ;  Pushes all the registers and segregs
        ;  and flags onto the stack.  Use with
        ;  cpop() to restore in correct order.

        PUBLIC  CPUSH
        IF      LPROG
CPUSH   PROC    FAR
        ELSE
CPUSH   PROC    NEAR
        ENDIF

        POP     STORAGE.RRT
        POP     STORAGE.RIP     ; SAVE RETI IP,
        POP     STORAGE.RCS     ; SAVE RETI CS,
        POP     STORAGE.RFL     ; SAVE THE FLAGS,
        MOV     STORAGE.RAX,AX  ; AND TUCK AWAY
```

continued

stack overflows, handle command-line arguments to change the stack size, redirect I/O, and perform other incidental operations. The code for all this is in the c.asm file; its object module is in c.obj. This code is loaded before main( ) and cannot be efficiently deallocated by any means other than actually editing out unused portions of c.asm and recompiling the file. A knowledgeable programmer should be able to remove large portions of c.asm for many applications; I have reduced considerable space in mine.

Interrupts

Now that I've shown you how to load programs into memory and keep them resident, I want to examine the best possible way to maintain "nice" programs. My main concern is with saving registers and flags because of the amount of calls and subroutines normally found in a C program. (You can see an example of this in listing 1.)

Since I passed the address of cpush( ) to the interrupt vector, the program's first act when it is entered is a call to cpush( ). This call pushes a return address on the stack, one that would not be there if the code were generated in assembly language. This problem is repeated throughout the program, so it must be handled early on.

The three modules in listing 7 show one of the fastest and most efficient solutions I found. Upon entry into the program, I call cpush( ). This routine stores the short-call return address, the interrupting program's return CS and IP, and the FLAGS that are pushed onto the stack. It then stores the registers and segment registers in its own allocated memory. The short-call return address is then pushed back onto the stack and the function returns to the body of the program.

After the interrupt routine does its work (in the example given in listing 2, it prints "Hello world"), it calls cpop( ) to return to the interrupted program. The cpop( ) routine emulates a pop of all the registers that should have been pushed onto the stack upon entry into the interrupt handler and then does an IRET. (For debugging purposes, I have also included the code

continued

Borland's Turbo Lightning™ FREE

Enlarged *Shift* keys

Two *Ctrl* and *Alt* keys for ambidextrous access.

Positive-tactile, firm-feel keys.

12 *Function* keys for increased automatic operation.

Extra-wide, easy-to-find *Return* key. *IBM changed sizes again by shrinking their Return key.*

Dedicated *Function Control* keys.

Caps, Num and *Scroll* Lock indicator lights. *IBM has no lights on their XT.*

Separate dedicated *Numeric Pad* with enlarged *Enter* key, four *Arithmetic Function* keys.

Isolated *Escape* key.

Switch-selectable compatibility with IBM, PC, XT, AT, PCjr, AT&T and all compatibles. *IBM's new Enhanced Keyboard runs only on their new XT's, AT's and ignores their installed base which probably includes you.*

Separate *Cursor* and *Screen Control* keys.



Switch allows you to swap position of *Ctrl* and *Caps* lock. *IBM moved Ctrl to bottom row, you have no choice!*

Here it is...DATADESK'S *TURBO-101 ENHANCED KEYBOARD*

for the 10 million PC users IBM just ignored!

IBM just announced their new redesigned "standard" keyboard for personal computers. There's only one problem: *it won't work* on your IBM computer if it was purchased prior to June 1986 or on *any* PC compatible purchased at any time!

Not to worry. Our new *Turbo-101* Enhanced Keyboard gives you the layout and enhancements of the IBM with some logical improvements (see above photo). And it works on your existing PC, XT, AT, PCjr, AT&T, Epson and virtually all compatibles!

Get Borland's Turbo Lightning ™ For FREE!



To really turbocharge your productivity, we are including, free-of-charge, Borland's red-hot Turbo Lightning software with each keyboard. Now, when using SideKick, WordPerfect, Microsoft Word, 1-2-3 or most popular programs, our Turbo-101 Keyboard will check your spelling *as you type*, gives you instant access to Random House's 80,000-word Concise Dictionary and 60,000-word Thesaurus and much, much more!

"Lightning's good enough to make programmers and users cheer, executives of other software companies weep," **says Jim Seymour of PC Week. Sold separately, Turbo Lightning retails for $99.95!**

The Turbo-101 is the best data entry tool since the pencil!

For users of spreadsheets like 1-2-3, the Turbo-101's *separate* cursor controls and numeric keypad makes entering numeric data into cells and moving from cell to cell as natural as moving your fingers. And for *word-processing,* the *'Selectric'* typewriter layout makes the Turbo-101 as easy to use as a pencil; and with the extra large Enter, Shift & Control Keys, you'll make so few mistakes, you won't even need an eraser!

SPECIAL OFFER!

ONLY $149.95* *FOR BOTH KEYBOARD & SOFTWARE*

Includes 30-day money back guarantee and 2 year full warranty. To prove that we don't ignore you or your pocketbook, you get our Turbo-101 Enhanced Keyboard and Borland's Turbo Lightning for an astounding $149.95.* No, you didn't read it wrong. During this amazing ***Introductory Offer*** you get both keyboard and software for less than most software programs by themselves! Now, if you're still feeling ignored, you can always do what you-know-who wants you to do...*and buy a new computer to get their keyboard!*

Up to now, DataDesk International may be one of the best kept secrets, but here's what's being said about our first *end-user* Keyboard/Borland software bundle:

"Who Can Pass Up a Deal? Department. Talk about an aggressive product!"
John C. Dvorak, InfoWorld Mar 86

"It solves all of the problems exhibited by their regular PC/XT keyboard...it's a great bargain!"
PC Productivity Digest May 86

"DataDesk Intl. has designed a sturdy and handsome keyboard that has tactile response...is the hardware bargain of the year" says Charles Humble, Oregonian Jan 86

"The best part of the keyboard is the way it feels. It's ideal! And fast. I've never worked on a keyboard with a nicer touch."
Business Computer Digest Aug 86

"It's a good keyboard. Good feel: the keys have tactile feedback. No mush at all. This is about as good a keyboard deal as you're likely to find...I have absolutely no hesitation in recommending the Model PC8700."
Jerry Pournelle, Byte Magazine Sept. 86

"This keyboard is neat to type on and feels solid. It has tactile feedback keys...I can type much faster on it."
Test Drive Scorecard: DataDesk-10 Key Tronics-9 Teleconnect Magazine May 86

BOTH TURBO-101 ENHANCED™ KEYBOARD AND BORLAND'S TURBO LIGHTNING™ SOFTWARE FOR ONLY:

$149.95* LIMITED OFFER

*Plus $10 Shipping & Handling. California Residents Add $8.75 Per Unit Sales Tax

NO. UNITS:_____
PAYMENT: ☐VISA ☐MC ☐CHECK
AMOUNT ENCLOSED: $_____

Enter

NAME:_____
ADDRESS:_____ STATE:_____ ZIP:_____
CITY:_____ COMPUTER TYPE:_____
PHONE:_____ EXP:_____
CC NO.:_____

The Only Alternative

datadesk™
INTERNATIONAL

7650 Haskell Avenue
Van Nuys, California 91406 (818) 780-1673

credit card orders call
(800) 826-5398
in CA call
(800) 592-9602

*Price does not include adaptor cables required by certain compatibles • A Limited offer—price subject to change without notification.

MADE IN USA

Turbo-101 is a trademark of DataDesk International. Turbo Lightning is a trademark of Borland International. IBM and IBM AT are registered trademarks of International Business Machines, Inc.

Inquiry 85 for End-Users.
Inquiry 86 for DEALERS ONLY.

```
        MOV     STORAGE.RBX,BX  ; ALL REGISTERS.
        MOV     STORAGE.RCX,CX
        MOV     STORAGE.RDX,DX
        MOV     STORAGE.RDI,DI
        MOV     STORAGE.RSI,SI
        MOV     STORAGE.RDS,DS  ; GET THE SEGMENT
        MOV     STORAGE.RSS,SS  ; REGISTERS.
        MOV     STORAGE.RES,ES
        PUSH    STORAGE.RRT     ; PUT CALL RETURN
                                ; ADDRESS ON STACK.
        RET
CPUSH   ENDP

        PUBLIC  CPOP
        IF      LPROG
CPOP    PROC    FAR
        ELSE
CPOP    PROC    NEAR
        ENDIF

        PUSH    STORAGE.RFL     ; RESTORE FLAGS.
        PUSH    STORAGE.RCS     ; RESTORE CS,
        PUSH    STORAGE.RIP     ; THEN IP.
        MOV     ES,STORAGE.RES
        MOV     DS,STORAGE.RDS
        MOV     SI,STORAGE.RSI
        MOV     DI,STORAGE.RDI
        MOV     DX,STORAGE.RDX
        MOV     CX,STORAGE.RCX
        MOV     BX,STORAGE.RBX  ; READY FOR IRET
        MOV     AX,STORAGE.RAX  ; WITH OLD IP AND
        IRET                    ; STUFF ON STACK.
CPOP    ENDP

        PUBLIC  CPOPT
        IF      LPROG
CPOPT   PROC    FAR
        ELSE
CPOPT   PROC    NEAR
        ENDIF
        PUSH    STORAGE.RFL     ; RESTORE FLAGS.
        PUSH    STORAGE.RCS     ; RESTORE CS,
        PUSH    STORAGE.RIP     ; THEN IP.
        MOV     ES,STORAGE.RES
        MOV     DS,STORAGE.RDS
        MOV     SI,STORAGE.RSI
        MOV     DI,STORAGE.RDI
        MOV     DX,STORAGE.RDX
        MOV     CX,STORAGE.RCX
        MOV     BX,STORAGE.RBX  ; READY FOR IRET
        MOV     AX,STORAGE.RAX  ; WITH OLD IP AND
        RET                     ; STUFF ON STACK.

CPOPT   ENDP
        ENDPS
        END
```

for cpopt( ), which is similar to cpop( ) except that cpopt( ) exits via a RET instruction.)

Summary

I've demonstrated a simple interrupt-processing program that remains resident in memory. Programs written using these techniques should have proper attention to good program structure and correct manipulation of pointers and addresses.

This project turned out to be more ambitious than I originally thought. The entry and exit routines posed the most problem; testing and debugging sometimes left the machine in a corrupted state. Be certain that your C programs can pass lint before using them; remember, you are creating an extension of DOS. I did notice that including structures in a program compiled with Lattice increased the address of the entry point by three. It makes a call after main( ) to set up the memory for the structs and/or unions. I am interested in feedback about improving any of these techniques. ■

Inquiry 133

MAKE YOUR PC SEEM LIKE AN AT!

MAKE YOUR AT SEEM LIKE A DREAM MACHINE!

ANSI-tm CONSOLE

The Integrated Console Utility™

FAST, POWERFUL ANSI.SYS REPLACEMENT

For the IBM-PC, AT, and clones

New Version 2.00 is MUCH FASTER!
Now blink free scrolling on CGA!

Now uses EMS/EEMS for Scroll Recall
New Menu Program for Changing Options

GET A BOX FULL OF UTILITIES!
MAKE LIFE EASIER FOR ONLY $75!

- Speed up your screenwriting 2-6x
- Extend your ANSI.SYS to full VT100
- Add many more escape sequences
- Scroll lines back onto screen
- Save scrolled lines into a file
- Add zip to your cursor keys
- Free your eyes from scroll blinking
- Easy installation
- Get a 43 line screen w/EGA
- Get a 50 line screen w/CGA
- No more annoying typeahead beep
- Prevent screen phospher burnin
- Control many programs' use of color
- Generate breakpts from keyboard
- Shorten that annoying bell
- Over 50 other useful options

"The psychological difference is astonishing"
—*Lotus* June 85 pg 8.

"So many handy functions rolled into one unobtrusive package"
—*PC-World* Feb 86 pg 282.

"The support provided by the publishers is extraordinary"
—*Capital PC Monitor* May 86 pg 25.

"... the best choice for improving your console ..."
—*Capital PC Monitor* June 86 pg 26.

460p Manual (w/slip case) & disks $75.

Satisfaction Guaranteed!
Order Yours Today!

HERSEY MICRO CONSULTING
Box 8276, Ann Arbor, MI 48107
(313) 994-3259 VISA/MC/Amex

DEALER INQUIRIES INVITED

Fast ANSI Console Driver

Fast ANSI Console Driver



Inquiry 316 ⟶


HIGH POWER
LOW PRICE $495
COMPLETE
The Baby AT
VISA and MasterCard accepted
Immediate Delivery
To order call 1-800-247-6413
• Factory direct
• 100% IBM AT compatible
• XT size board and mounting holes
• 6/10 Mhz processor speed (6/8 Mhz available)
• On board memory to 1 Mb
• Zero wait states at 10 Mhz standard
• 10 Mhz 80286 CPU
• 80287 Math co-processor socket
• 7 expansion slots (4 dual 62/36 pin and 3 single 62 pin)
• Serial port on board
• Advanced Gate-array Chips, extremely stable and reliable
• Highly reliable 4 layer circuit board construction
• On board lithium batteries for system parameters and real time clock
• Standard speaker, keyboard, lock, external battery, and power connectors
• Legal Award BIOS
• Internal cable assembly for serial port provided
• Setup programs included
Turn-Point America
P.O. Box 71016
150 N. Center St., Suite 224
Reno, NV 89570
Tel: (702) 786-4484
Telex: 650 308 4898 MCI
Fax: (702) 826-6741
TRADEMARKS and REGISTERED TRADEMARKS: IBM AT — International Business Machines Corporation.

When you want to talk computers...

HOME COMPUTERS.

Atari Computers

520ST Monochrome System	$499.00
520ST Color System	749.00
1040ST Color System	859.00
800XL 64K Computer	63.99
65XE 64K Computer	97.99
130XE 132K Computer	129.00

Atari Peripherals

1020 Color Printer	29.99
1050 Disk Drive	129.00
835 300 Baud Modem	24.99
850 Atari Interface	109.00
M301 300 Baud Modem	39.99
XM801 80-Column Printer	199.00
XM804 ST Printer	189.00
ICD PR Connection	59.99



Amiga System Package $1199

Includes: Amiga CPU, 256K RAM expansion, RGB Monitor, Amiga DOS, Basic, Tutorial, Kaleidoscope, Voice Library.

Commodore Computers

Commodore-64C 64K Computer	189.00
Commodore-64C System w/1802C	539.00
Commodore-128 128K Computer	259.00
Commodore-128 System	759.00
Amiga 1000 256K Computer	849.00

Commodore Peripherals

1530 Data Cassette	34.99
1660 Commodore Modem	59.99
1670 Commodore Modem	99.99
1541C Disk Drive	189.00
1571 Disk Drive	249.00
1802 Color Monitor	199.00
1902 Color Monitor	299.00
Amiga 1010 3½" Ext. Drive	219.00
Amiga 1020 5¼" Ext. Drive	189.00
Amiga 1080 RGB Monitor	269.00
C128 512K Expansion Board	179.00
PPI Parallel Printer Interface	34.99
Xetec S/Graphix 8K	69.99
Micro R&D MW350	44.99

MS/DOS SYSTEMS.



PC-T00 20 Meg XT-Compatible $999

AT&T 6300	from $1299.00
Compaq	from 1699.00
Cordata	from 899.00
IBM-XT	from 1099.00
IBM-AT	from 2699.00
Leading Edge	from 999.00
Panasonic Business Partner	from 799.00
Toshiba 1100 Plus	from 1749.00

MULTIFUNCTION CARDS.

AST

Six Pak Plus PC/XT	$169.00
Six Pak Premium PC/XT	249.00
Advantage-AT 128K	339.00

Everex

EV-221 Evergraphics Mono	139.00
EV-640 Edge Card	259.00

Hercules

Color Card	159.00
Graphics Card Plus	209.00

Fifth Generation

Logical Connection 256K	329.00

IDEAssociates

IDE-5251 Local Emulator	579.00

Intel

1110 PC Above Board	279.00
Inboard 386K 0K	Call

NEC

GB-1 EGA	409.00

Quadram

Quad Ega+ Graphics Adapter	329.00
Silver Quadboard	129.00
Expanded Quadboard	119.00

VIDEO 7

EGA Video Adapter	329.00

Zuckerboard

Color Card w/Parallel	89.99
Monochrome Card w/Parallel	99.99
576K Memory Card	59.99

DRIVES.

Allied Technology

Apple Half-Heights	$109.00
Controller Card	39.99

CMS

Drive Plus 20MB Internal Card	399.00

Everex

Stream 20 20MB Tape-Backup	669.00

Genie Technology

210 H 10 + 10 subsystem	1749.00

Indus

Atari GT Disk Drive	189.00
Commodore GT Disk Drive	189.00

Iomega

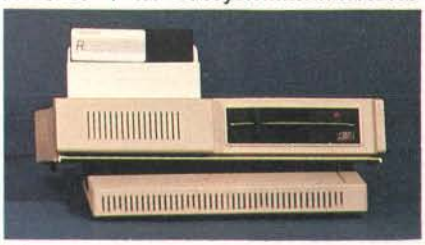
A210H 10 + 10 Bernoulli Box	1899.00
A220H 20+20 Bernoulli Box	2499.00

Irwin

110 D 10MB Tape backup	319.00

Mountain Computer

Drive Card 20MB Internal Card	649.00
A220 20 + 20 Subsystem	2199.00



Racore Jr. Expansion w/DMA $319

Seagate

ST-225 w/Controller	399.00

Toshiba

Half-Height 360K internal	89.99

DISKETTES.

Maxell

MD-1 SS/DD 5¼"	$8.99
MD-2 DS/DD 5¼"	10.99
MD-2HD Hi-Density 5¼"	21.99
MF-1 SS/DD 3½"	12.99
MF-2 DS/DD 3½"	21.49
CS-500 20Mb Streamer Tape	11.99
CS-600 60Mb Streamer Tape	13.49

Sony

MD1 SS/DD 5¼"	8.49
MD2 DS/DD 5¼"	9.99
MD-2HD Hi-Density 5¼"	22.49
MFD-1 SS/DD 3½"	14.49
MFD-2 DS/DD 3½"	20.49



COMPUTER MAIL ORDER

.....When you want to talk price.

MONITORS.

Amdek
Video 310A Amber TTL.....$149.00
Color 722 RGB, CGA/EGA.....499.00
Magnavox
8CM515 RGB Monitor-80.....289.00
7BM623 PC Monitor-80 Amber.....99.99
Mitsubishi
XC 1409C 14" RGB.....319.00
NAP
873 14" Multimode.....549.00
NEC
12" TTL Green or Amber.....129.00
JC-1401P3A Multi-Sync.....Call
Princeton Graphics
MAX-12 12" Amber TTL.....169.00
HX-12 12" Color RGB.....429.00
HX-12E 12"RGB/EGA.....499.00
Quadram
8460 Quadchrome Enhanced.....439.00
Taxan
Model 124 12" Amber.....139.00

MODEMS.

Anchor
6480 C64/128 1200 Baud.....$119.00
Omega 80 Amiga.....129.00
VM520 ST520/1040 1200 Baud...139.00
Expressi PC-1200 Half Card.....149.00



Everex
1200 Baud Internal $119

Hayes
Smartmodem 300 External.....139.00
Smartmodem 1200B Internal.....359.00
Smartmodem 2400B Internal.....539.00
Practical Peripherals
Practical Modem 1200 External...159.00
Quadram
Quadmodem II 1200 Baud.....299.00
Supra
MPP-1064 AD/AA C64.....69.99
1200AT 1200 Baud Atari.....149.00
U.S. Robotics
2400 Baud Internal.....189.00

PRINTERS.

Canon
LBP-8A1 Laser, 8 Page/Min.....$1899.00
Citizen
MSP-10 160 cps, 80-Column.....319.00
MSP-20 200 cps, 8K Buffer.....349.00
Premier 35 35 cps Daisywheel....499.00
C.Itoh
8510-SP 180 cps, 80-Column.....Call
310-SEP Epson/IBM 80-Column.....Call
Cordata
The Desktop Printshop Laser.....2199.00



Epson LX-86
120 cps, Dot Matrix $199

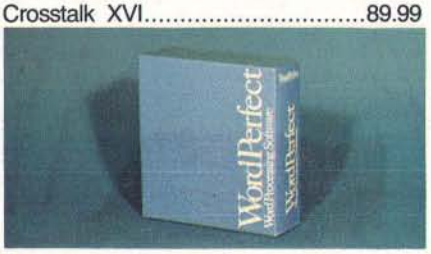
Epson
FX-86E 240 cps, 80-Column.....Call
FX-286E 240 cps, 132-Column.....Call
EX-800 300 cps, 80-Column.....459.00
LQ-800 180 cps, 24-Wire Printhead..Call
Juki
6300 40 cps Daisywheel.....699.00
6100 10 cps Daisywheel.....429.00
5510C Color Dot Matrix.....449.00
NEC
Pinwriter 660 24 Wire.....489.00
Pinwriter 760 24 Wire.....689.00
Okidata
ML-182 120 cps, 80-Column.....219.00
ML-192+ 200 cps, 80-Column....369.00
ML-193+ 200 cps, 132-Column.....Call
ML-292 200 cps, 80-Column.....Call
ML-293 200 cps, 132-Column.....Call
Panasonic
KX-1080i 120 cps, 80-Column.....219.00
KX-1091i 180 cps, 80-Column.....299.00
KX-1592 180 cps, 132-Column.....439.00
Star Micronics
NX-10C 120 cps, C64 Interface...219.00
NX-10 120 cps, 80-Column.....219.00
NX-15 120 cps, 132-Column.....379.00
Texas Instrument
TI-855 150 cps, 80-Column.....599.00
Toshiba
P321 216 cps, 24-Pin Printhead...479.00
P341 216 cps, 24-Pin Printhead...589.00

SOFTWARE.

FOR AMIGA
Aegis Development
Animator & Images.....$99.99
Commodore
Textcraft/Graphcraft.....59.99
Electronic Arts
Deluxe Paint.....64.99
Microillusions
Dynamic CAD.....359.00
Micro Systems
Scribble Word Processor.....79.99
Sublogic
Flight Simulator II.....37.99

FOR ATARI ST
Access
Leader Board Golf.....27.99
Batteries Included
D.E.G.A.S. Elite.....59.99
Microprose
Silent Service.....29.99
Paradox
Wanderer 3D.....29.99
Sublogic
Flight Simulator II.....37.99
Timeworks
Swiftcalc.....54.99

FOR IBM
Ashton-Tate
d-Base III+.....429.00
5th Generation
Fastback Utility.....89.99
IMSI
Optimouse w/Dr. Halo.....99.99
Lotus
Lotus 1-2-3.....329.00
MicroPro
Wordstar Professional w/GL.....189.00
Microstuf
Crosstalk XVI.....89.99



Satellite Systems
Word Perfect 4.2 $209

P.F.S.
First Choice.....99.99

In the U.S.A. and in Canada

Call toll-free: 1-800-233-8950.

Outside the U.S.A. call 717-327-9575 Telex 5106017898

Educational, Governmental and Corporate Organizations call toll-free 1-800-221-4283

CMO. 477 East Third Street, Dept. A103, Williamsport, PA 17701

ALL MAJOR CREDIT CARDS ACCEPTED.

POLICY: Add 3% (minimum $7.00) shipping and handling. Larger shipments may require additional charges. Personal and company checks require 3 weeks to clear. For faster delivery use your credit card or send cashier's check or bank money order. Pennsylvania residents add 6% sales tax. All prices are U.S.A. prices and are subject to change and all items are subject to availability. Defective software will be replaced with the same item only. Hardware will be replaced or repaired at our discretion within the terms and limits of the manufacturer's warranty. We cannot guarantee compatibility. All sales are final and returned shipments are subject to a restocking fee.

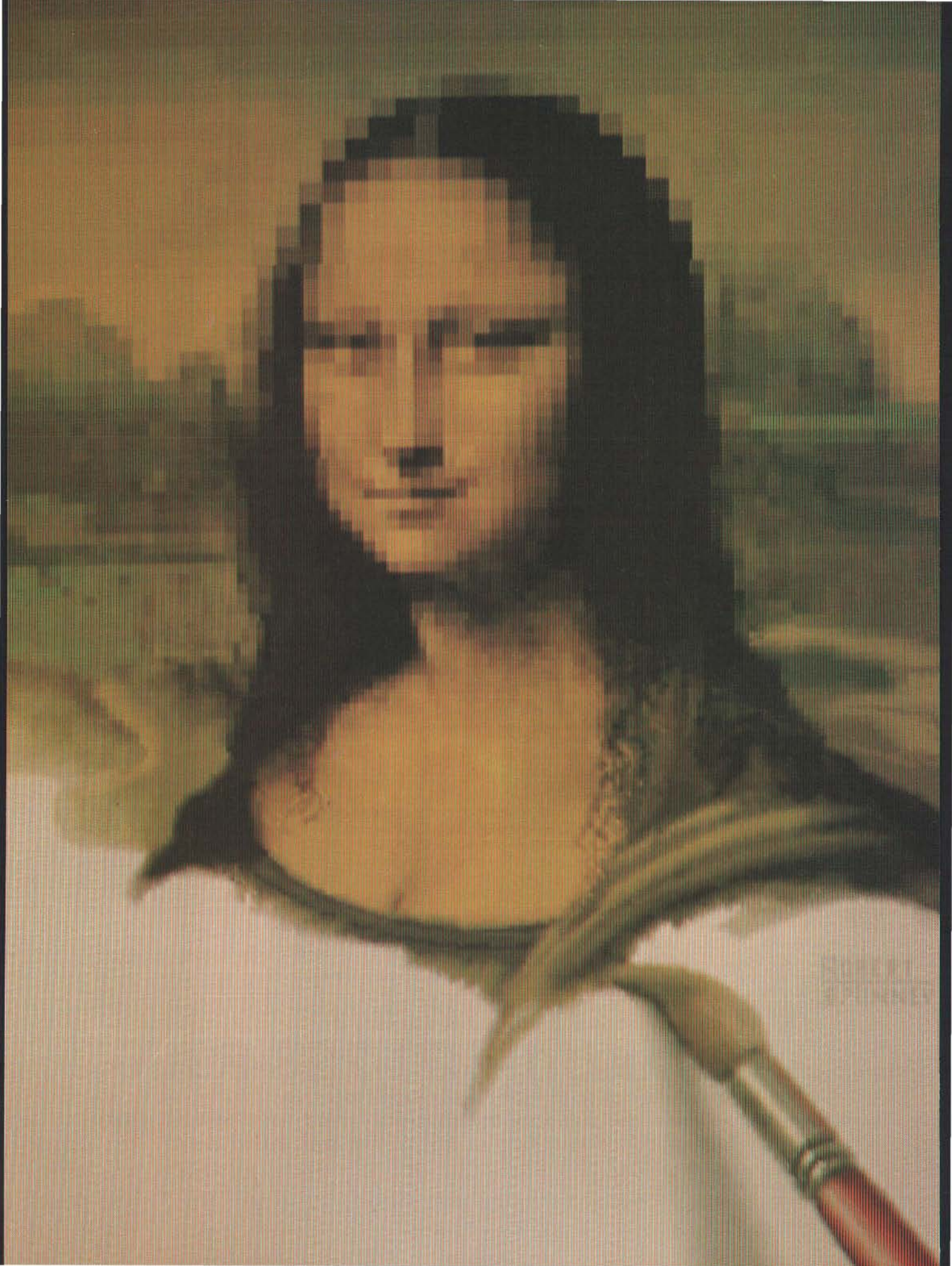


Image Processing

Probing Space by Camera
by Ken Sheldon 143

Digital Image Processing in Art Conservation
by John F. Asmus 151

Introduction to Image Processing Algorithms
by Benjamin M. Dawson 169

Low-Cost Image Processing
by Charles McManis 191

PreScript
by Ken Sheldon 197

IN THE SIMPLEST SENSE, image processing means manipulating an image. This could be as mundane as changing the contrast on your TV set. With the advent of digital computers, however, researchers have found that there is literally more to most images than meets the eye.

This month's theme focuses on digital image processing, an exciting technology that breaks images down into a series of digital values representing such things as the brightness and color at every given point in the image. By manipulating this data via computer, researchers have been able to improve images, uncover new information in them, and even begin to interpret their meaning, the initial step in developing machines that can "see."

The first article, "Probing Space by Camera" describes the development of image processing at NASA's Jet Propulsion Laboratory, and its transition from a fanciful idea to an integral part of man's exploration of space. Perhaps the first real "spin-off from space," image processing's initial down-to-Earth application was in biomedical studies, an area where scientists are making astounding advances, as shown in the text box accompanying the article.

Our journey through space and time then takes us back to the *Mona Lisa*, who has been receiving a computerized face-lift thanks to image processing. In "Digital Image Processing in Art Conservation," Dr. John Asmus details his work with the most famous painting of all time. Then, on a more modern note, we will examine the controversial practice of "colorizing" classic movies, thanks to—or no thanks to, depending on how you look at it—image processing.

Ben Dawson, coauthor of the award-winning article on how image processing helped find the long-lost Titanic (see "Finding the Titanic," March 1986 BYTE), has written "Introduction to Image Processing Algorithms," a clear but in-depth look at the computational basis for image enhancement, complete with a set of C routines that you can adapt to your own computer system.

Charles McManis, who works for a maker of large, expensive workstations, has written "Low-Cost Image Processing," which tells you how to turn an Amiga into your own image processing workstation. He has also written a couple of C programs that are ready to run on the Amiga.

Image processing is not desktop publishing, although some of the devices involved with desktop publishing, such as image scanners and cameras, use image processing technology at their lowest levels to improve images after scanning. The article on PreScript describes a proposed standard for capturing and enhancing images that are to be incorporated into desktop publishing and other applications.

Nor does image processing include paint programs, by which you physically move bits around with the use of a pointing device. But as paint programs become more powerful, the lines—if you'll pardon the pun—are getting harder to draw between technologies. The TrueVision Image Processing System, for example, uses image processing at low levels to perform operations like tinting and shading. In this month's review section, Robert Tinney, BYTE's quintessential cover artist, reviews the TrueVision system, which he used to produce the cover and section art for this issue.

Image processing, once a game that could only be played on large, expensive computer systems, is the latest area of computer science to fall before the burgeoning power of small computers. Like data processing and word processing, image processing is beginning to crest into a widespread phenomenon; this month's theme will help you catch the wave early.

—Ken Sheldon, Technical Editor

Creating With
Pictures
Just Got Easier!

Professional Image Board



The new Professional Image Board is a PC board which allows an ordinary home video camera (color or black-and-white) to be plugged into an IBM personal computer or IBM compatible. Now, live, fast action scenes can be instantly captured in full color and frozen. The frozen pictures can be computer enhanced feature by feature and stored on a floppy or hard disk. The frozen pictures can also be transmitted to any remote computer in the world via modem. The Professional Image Board also allows you to perform cut and paste operations with most popular software.

SPECIFICATIONS

- Works with IBM PC/XT/AT or compatible
- Capture one picture in 1/60 second from standard NTSC signal source (Regular video camera, VCR, etc., or RGB camera)
- Shows picture on analog monitor or TV
- Resolution 512 x 256 capable of 32K different colors
- Adding text on the captured picture
- Mixing external image with internal image in live mode
- Image captured by PIB can be displayed on EGA monitor
- Adapter available for European standard TV



Unretouched frozen video image in full color. Captured with ATronics' Professional Image Board.

ATI **ATronics International Inc.**
We Deliver Advanced Technology

1830 McCandless Dr. Milpitas CA 95035
(408) 943-6629

Inquiry 33

Probing Space by Camera

The development of image processing at NASA's Jet Propulsion Laboratory

Ken Sheldon

EARLY MORNING, JULY 31, 1964. The mood at NASA's Jet Propulsion Laboratory (JPL) was tense; the American space program was in trouble.

Since the onset of the space age in 1957, the Soviet Union had been racing ahead of the United States, scoring an impressive string of firsts: Sputnik I, the first man-made satellite to successfully orbit Earth; Sputnik II, which carried the first living creature (a small dog) into space; Luna I, the first space probe to fly past the moon; Luna II, the first probe to crash on the moon; and Luna III, which transmitted back to Earth the first images of the far side of the moon ever seen by man.

Meanwhile, the United States' early probes were disasters. They blew up on the launch pad. They failed to escape Earth's gravity.

The Ranger probes, designed to return photographs and data from the moon in preparation for landing a man on the lunar surface, had also been riddled with failures: Two of them failed to leave Earth orbit and came flaming back into the atmosphere; one crashed mutely on the moon, none of its equipment having functioned since lift-off; and two escaped Earth orbit but missed the moon by thousands of miles and refused to point their cameras in the right direction.

Ranger 6 had come heartbreakingly close. It performed flawlessly, leaving Earth orbit and impacting on the moon's Sea of Tranquillity according to plan, but a freak accident that occurred at lift-off prevented its television cameras from turning on or relaying a single image back to Earth.

As Ranger 7 lifted off from Cape Canaveral on July 28, 1964, a congressional investigation was under way, with some members of Congress calling for JPL—and the space program—to shut down. JPL researchers had been unable to determine the cause of the accident that crippled Ranger 6's cameras. And no one knew whether the changes they had made to Ranger 7's cameras would prevent the problem from recurring. No more Ranger probes were waiting in the wings; Ranger 7 was the space program's "last best hope."

On the morning of July 31, 1964, Ranger 7 neared its lunar destination. Reporters and JPL staff waited anxiously, the memory of Ranger 6's failure still fresh in their minds.

At 6:08 a.m., the word came from Goldstone Tracking Station to JPL: Ranger 7 was transmitting full-power video signals from the moon. In the 17 minutes before its impact onto the lunar surface at the Sea of Clouds, Ranger 7 transmitted the first highly detailed images of the moon—over 4300 of them—back to a cheering JPL. As NASA historian R. Cargill Hall says, "Ranger 7 was a resounding, a crashing success." (*Lunar Impact, A History of Project Ranger,* U.S. Government Printing Office, 1977.)

The Image of Ranger

Throughout the long days of waiting for a successful Ranger mission, Dr. Robert Nathan had been perfecting techniques that would improve the images sent back from the moon. Nathan, a crystallographer by training, had come to JPL from the California Institute of Technology, where his research involved creating images of the microscopic structure of crystals by computer processing their diffraction patterns. His assignment at JPL was to apply his knowledge of digital techniques to the data being sent back from America's early space probes.

Nathan had studied the images captured by the analog cameras on the Soviet Union's Luna III. The photographs were grainy, out of focus, and distorted by signal noise. He knew he could do better.

"Prior to that time, both the Americans and the Soviets were using analog techniques to transmit pictures from space, and the Soviets were using analog methods to enhance the pictures," Nathan says. "I could see right away that manipulating image data was too difficult if everything remained in analog form."

Nathan suggested digitizing the analog video images and adapting the techniques of one-dimensional signal processing to process the two-dimensional images with the help of computers. It was the germ of a great idea.

The Vidicon television cameras that sent video signals from Ranger 7 back to Earth were the best available at the time. But they had three problems.

The first problem was geometric distortion. The beam that swept electrons across the face of the tube in the spacecraft's

continued

Ken Sheldon is a technical editor for BYTE. *He can be reached at BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.*

camera moved at nonuniform rates that varied from the beam on the playback tube reproducing the image on Earth. As a result, the pictures were sometimes lopsided, stretched, or otherwise distorted.

Another problem with the cameras was photometric nonlinearity. When aimed at a uniform white or gray field, the cameras displayed a brightness in the center and a darkness around the edge caused by a nonuniform response of the phosphor on the tube's surface.

Finally, oscillation in the cameras' electronics was "bleeding" into the video signal and producing a rug-like noise pattern visible on the images' high-resolution playback.

Nathan designed a set of techniques to correct for the cameras' limitations. Correcting for the geometric distortion involved a "rubber sheeting" operation that "stretched" the images to match a preflight calibration and return them to their correct shape (see photo 1). The photometric error was measured on the ground and then filtered out of the images transmitted from space. To remove the oscillation noise, Nathan's team isolated an area of the image that should have been featureless, digitized the pattern there, and used that as a filter to subtract the pattern from the rest of the images (see photo 2).

The image-enhancement techniques developed by Nathan and others at JPL were used successfully on the images from Rangers 7, 8, and 9, which returned a total of 17,267 images of the moon. New techniques were discovered in the process: Nathan developed an image-enhancement technique known as deconvolution, which deblurred the images and improved resolution dramatically (photo 3). Thomas Rindfleisch used the Ranger images, the lunar shadows they revealed, and knowledge of the sun's angle to develop a method of photoclinometry. This technique produced elevation maps of the moon, which helped researchers select appropriate landing sites for later probes.

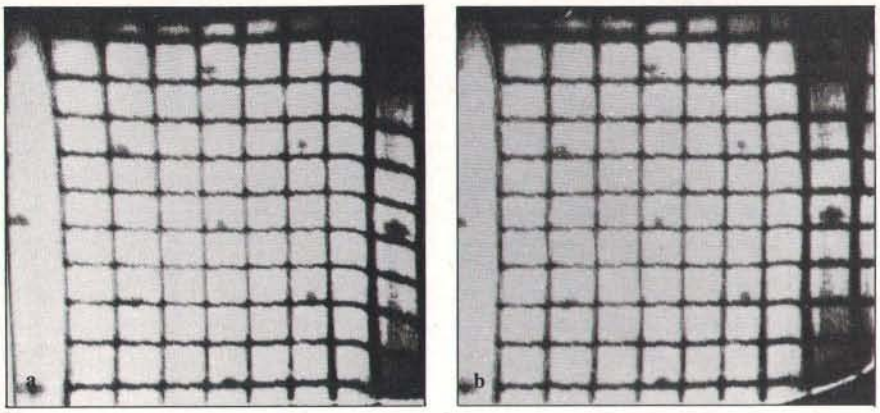


Photo 1: *Correcting for the geometric distortion of the Ranger cameras involved stretching the images to match a preflight calibration. (a) A calibration image from one of the Ranger's Vidicon cameras; (b) the image after stretching to correct for the camera's distortion. (All photos accompanying this article are courtesy of NASA/JPL.)*

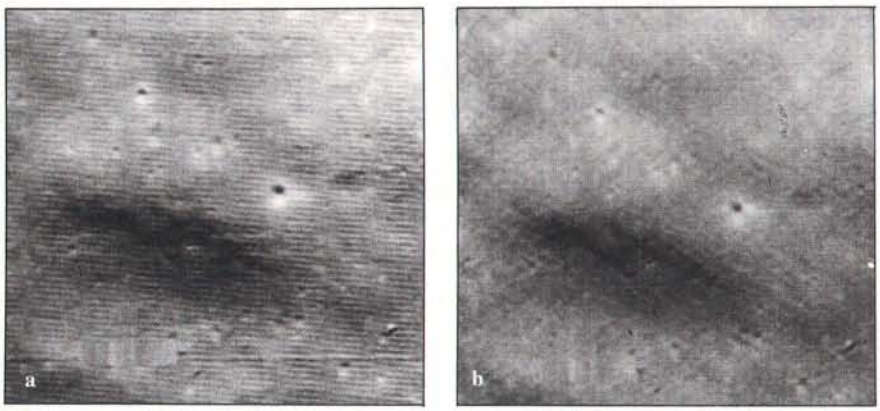


Photo 2: *To remove oscillation noise from Ranger images, JPL researchers isolated an area of the image that showed the noise pattern (a) and used that pattern as a filter to subtract the pattern from the rest of the image (b).*

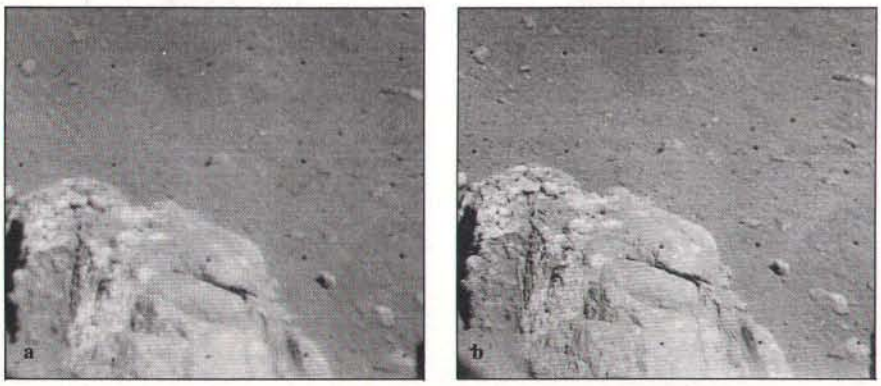


Photo 3: *Deconvolution, a technique developed during the Ranger missions, involves measuring a camera's tendency to blur high-frequency details and subtracting it from the transmitted images, as shown in these before (a) and after (b) images from a later Surveyor mission.*

On to Mars

Exactly four months after Ranger 7 lifted off from the pad at Cape Canaveral, Mariner 4 headed for Mars. It was the first of the Mars/Venus probes to carry a camera. It was also the first space probe to send its signals back to Earth in digital form, a format necessitated by the 48 million miles over which the data had to travel. At that distance, an analog signal would have been virtually indistinguishable from the background noise of space.

The data came in at the tedious rate of 8 bits (one pixel) per second. Nathan says, "It took eight hours for that very first frame of Mars to come in, and we didn't quite know what we were getting. Half of the image was dark sky, the other half was almost saturated white."

The researchers later realized that the problem was not with JPL's cameras but with Martian weather. Mariner 4 had arrived on an extremely cloudy day on Mars—a planetwide sandstorm, in fact—and the surface was hidden from the probe's cameras. Only later, on the tenth frame, did the sky clear up, and Mariner

4 sent back the first close-up images of the red planet's crater-pocked surface (see photo 4).

Image enhancement had proved its worth. In 1965, Nathan, Fred Billingsley, and Ben Martin of JPL's Central Computing Facility (where the image processing operations had been handled until then) convinced JPL to establish the Image Processing Laboratory (IPL) as a division of JPL, with its own computing facility built around an IBM 360/44.

With the establishment of the IPL, Nathan and Billingsley recommended that all future probes transmit their images back to earth digitally. However, plans for the next series of lunar probes, the Surveyor missions, were too far along for changes, and the probes transmitted analog video signals like those from the Ranger probes. Between 1966 and 1968, five Surveyor probes landed successfully—and softly—on the moon, transmitting back to the IPL over 87,000 analog images, which were digitized, enhanced, made into topographic maps, and so on (see photo 5). The images were invaluable in studying the nature of the moon's surface in preparation for the first manned landing there.

The Mariner missions were not over, however. Two probes remained, one each to Mars and Venus, and they carried digital equipment like that on Mariner 4. The cameras on the Mariner probes had a problem similar to that of the Ranger cameras: The images were marred by a noise pattern from the probes' power supply—they looked as if they were printed on herringbone tweed. Thomas Rindfleisch applied nonlinear algebra in a program called Despike, which performed a two-dimensional Fourier transform to produce a frequency spectrum with spikes that represented the noise elements (typically the highest frequency elements in an image). The program isolated the noise spikes, removed them, and transformed the data back into an image from which the herringbone pattern had been removed.

The Picture of Health

As the Mariner and Voyager probes continued, researchers at JPL began experimenting with the application of image-enhancement techniques to biomedical problems. Nathan applied the technology to electron microscope images of catalase (a liver enzyme). Research engineer Robert Selzer (now supervisor of the biomedical image processing group) ran x-rays of the human chest and skull through the computer, with a dramatic improvement in the visibility of blood vessels in the resulting images (see photo 6).

In 1967, Nathan and Selzer described their research at a UCLA School of Medicine forum sponsored by the National Institutes of Health. The NIH was so impressed with the results of their work that it offered to fund increased research in the area of biomedical image processing. Accepting the money took some maneuvering—although originally created to help the military with jet-assisted takeoff rockets, JPL had been exclusively a NASA facility since NASA's establish-

continued

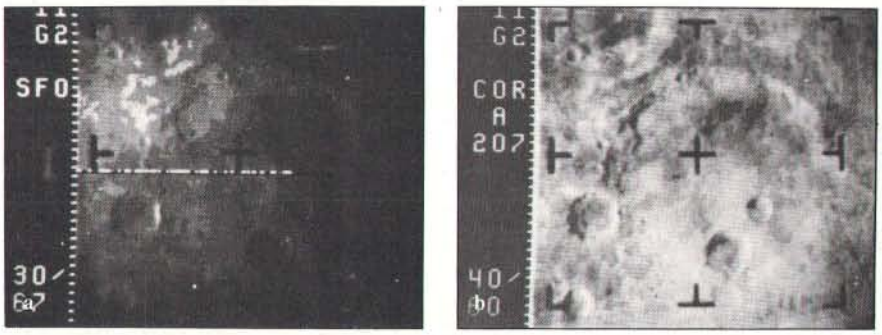


Photo 4: *(a) An image of Mars sent back by Mariner 4, among the first close-ups of the red planet seen by the human eye; (b) the same image after image enhancement.*

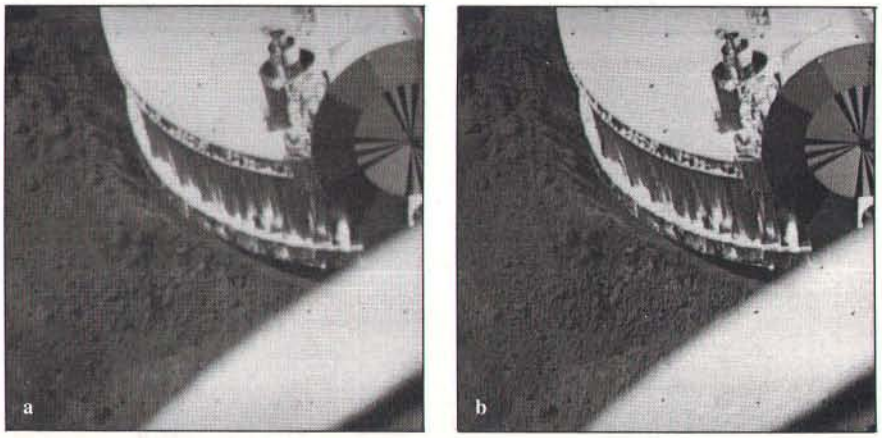


Photo 5: *By deconvoluting the images from the Surveyor probes of the moon (a) their resolution was dramatically improved (b).*

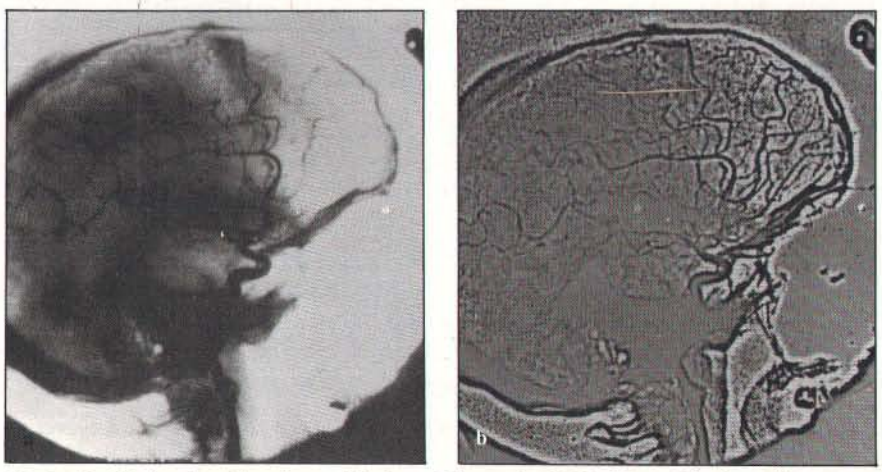


Photo 6: *Under the direction of Robert Selzer, the JPL's biomedical studies program helped pioneer the use of image processing in biomedical applications with images such as these. Note the dramatic improvement in the visibility of arteries in the front of the brain between these unprocessed (a) and enhanced (b) images of the human skull.*

From Outer Space to the Inner Man

Seeing inside the human body was first made possible by Wilhelm Roentgen's discovery in 1895 that x-rays (electromagnetic radiation of much higher frequency than visible light) could be used to create images of the body. When passed through the body, the rays are differentially absorbed by tissues, bones, and organs, and come out the other side to create an image on photographic film. Although the images are often blurred by patients' movement and can be difficult to read because organs are superimposed on top of one another, the photographic x-ray has long been one of the cornerstones of medical diagnostics.

Later discoveries used other types of energy to create images of the human body. Ultrasound, a kind of sonar for the body, uses sound waves that bounce off organs and echo back to a transducer that creates an image. Nuclear medicine uses a special camera that detects the emission of gamma rays from short-lived radioactive substances injected into the body. This technique lets physicians visualize organs, the passage of fluids through the organs, and various metabolic processes.

With the advent of the computer revolution, researchers began adapting digital techniques to these analog technologies. Although the original systems are still in use, several varieties of x-ray, ultrasound, nuclear medicine, and other radiologic systems now use A/D converters to create digital images, which have several advantages over analog images: Noise elements can be removed; contrast can be enhanced; several images of the same area can be "averaged" to remove extraneous elements; blurring caused by patient movement can be reduced; one image can be subtracted from another to show, for example, the contrasting material injected into the blood vessels of the heart, without bones, lungs, and other organs getting in the way (digital subtraction angiography); and the quantization, or measuring, of organs, tumors, etc., is much easier.

The latest imaging technologies are inherently digital. Magnetic resonance imaging (MRI) uses a strong magnetic field and the response of certain atomic nuclei (such as hydrogen) in the body to generate images. The Nobel prize–winning technology of computerized tomographic (CT) scanning uses an x-ray tube that travels around the body and transmits a thin x-ray beam to a detector traveling opposite it. A computer then reconstructs the digitized data to create a highly detailed "slice" through the body, as seen in photo A. Typically, several images are captured, providing a sequence of cross-sectional views through the area of interest.

Interpreting CT scan images can be difficult, even for expert diagnosticians.

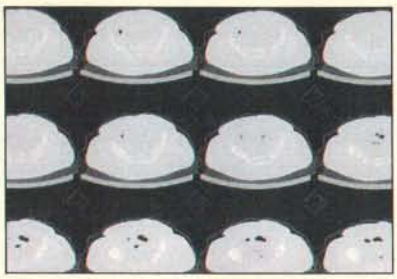


Photo A: *A series of cross-sectional slices through the human body, generated by a computerized tomographic scan.*



Photo B: *A Pixar display of an actual human pelvis. In the top half of the frame, the muscles and organs are shown in solid red. In the bottom half of the frame, they are transparent so that the bones can be seen.* © *1986 Pixar. All rights reserved.*



Photo C: *A VRT system display of an actual human pelvis using a conceptual internal light source to show up minute textural differences.* © *1986 Pixar. All rights reserved.*

Since a series of CT scans covers a finite volume, however, researchers have been able to reconstruct three-dimensional images of the body from the digitized two-dimensional data by "stacking up" the images and displaying them.

At the Johns Hopkins Medical Institutions, Dr. Eliot Fishman, head of the Division of Computed Body Tomography, employs volume-rendering techniques (VRT) on a Pixar Image Computer to re-create three-dimensional images of elusive imaging problems such as acetabular (hip socket) fractures. Researchers at Pixar, a spin-off of Lucasfilm (which created the space scenes for the movie *Star Wars*, among others), have developed a system that merges computer graphics with image processing and lets physicians view high-resolution images of patients' internal structures. These images can be rotated in real time, thanks to a parallel-processing chip that performs image processing operations at 10 million instructions per second.

The Pixar's frame buffer is 48 bits deep; every pixel can be represented by 48 bits—12 each for the colors red, green, and blue and 12 bits that control the degree of transparency. Thus, a physician can instruct the system to display muscles and organs as solid red (photo B, top) or make the organs transparent so that bones can be more easily visualized (photo B, bottom).

According to Dr. Fishman, "Volumetric rendering differs from standard surface rendering of three-dimensional images in that all of the information from the original CT scans can be preserved rather than just the surface boundaries." The VRT system, a collaborative effort between Johns Hopkins, Pixar, and Philips Medical Systems, allows researchers to shade the internal structures with a conceptual light source that shows up minute textural differences (photo C). Note that these photos are not computer-generated graphics, but images of the pelvis of an actual patient, built up from CT scans of the patient.

As new advances are made in both computer and radiological science, the synergy between the two will open up new avenues of exploration for researchers into the mysteries of the human body and provide new ways for physicians to diagnose and treat illnesses.

ment in 1958 and was reluctant to accept money from any other organization. Eventually, JPL approved receipt of NIH funds to pursue three areas of research: electron microscope studies under Nathan; x-ray studies under Selzer; and light-microscope studies under Dr. Kenneth Castleman.

Since its inception, the Life Sciences/Biomedical Program has used image processing to study the progression of atherosclerotic disease in coronary arteries, measure the size and density of muscle fibers to aid in the diagnosis of neuromuscular disorders, develop an automated Pap smear test for the detection of cervical cancer, and evaluate the degree of tissue damage in burn victims. The burn research, under the direction of Victor Anselmo, uses patient data obtained from a multispectral scanner originally developed for NASA's Landsat geological satellite. (See "Introduction to Image Processing" by Jeffrey L. Star, February 1985 BYTE, for a description of Landsat.) Another application of image processing to biomedicine is described in the text box "From Outer Space to the Inner Man" on page 146.

Back to the Laboratory

When funding for Nathan's NIH project ran out, he began looking for other areas of research. He worked on developing an automated method of finding cancer cells in the human body via image processing. Later, he was contracted by NASA's Ames Laboratory in San Francisco to improve the resolution of ultrasound images, which were being used to study the possibly harmful effects of weightlessness on the heart.

Meanwhile, image enhancement had become an integral part of JPL's space probes. With the later Mariner missions to Mars and Venus, the Viking probes of Mars, and the Voyager's spectacular "grand tour" of Jupiter, Saturn, Uranus, and Neptune, the trend turned to digitizing the images as close to the source as possible and transmitting them back to Earth digitally. While the basic image processing techniques changed little, efforts were made to increase the speed, efficiency, and capabilities of the imaging systems on board the probes and on the ground.

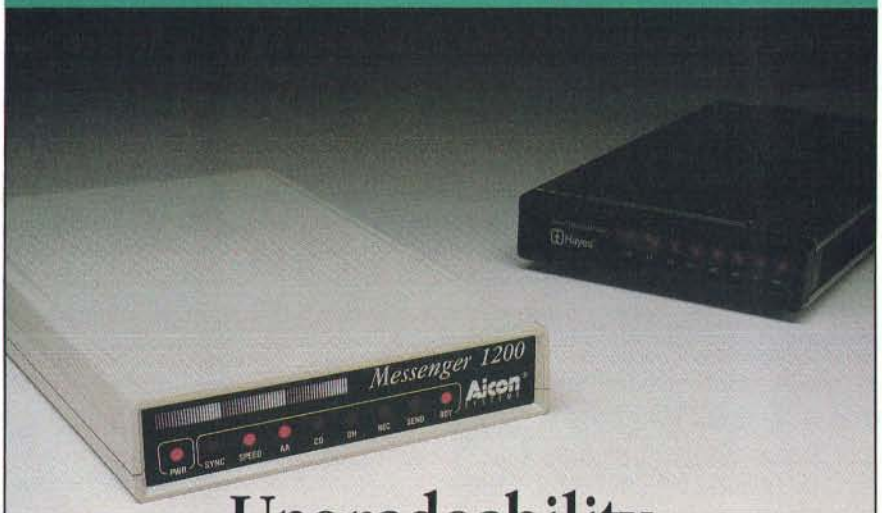
But image processing was running into the same bottleneck that other computer-related fields had faced: It was still essentially a slow serial operation. In other words, the basic operations of filtering and geometric transformation were being handled in a step-by-step, one-at-a-time manner by the computer's CPU. As long as data from space probes had been transmitted at only 8 bits per second, Earth-bound computers could easily keep up with the influx of data. But as numerous weather, geological, oceanographic, and commercial satellites were launched and began transmitting data to Earth at high speed, the data was piling up, and researchers could not find the time to process all of it.

At that time, Nathan realized that image processing wasn't being used in other areas of research because the massive amount of data being handled in many real-world applications made the process impractical. The limitations on image processing were not caused by the algorithms but by the available hardware. He began asking whether there was some way of developing new hardware that could perform these operations in parallel, with many chips operating simultaneously. This led to his introduction into the science of VLSI by Dr. George Lewicki, who was in charge of the electronics research area at JPL.

In 1985, Nathan completed work on a VLSI chip with five multipliers and accumulators. A hybrid carrier with seven of the chips mounted on it lets a total of

continued

The Advantage Is...



Upgradeability

At a fraction of the cost of the leading modem, the Messenger 1200™ is a brilliant investment in your computer system's future. Its many advanced features are highlighted by easy upgradeability to 2400 baud transmission (if your communication requirements increase). The Messenger 1200,™ it's got all the advantages.

- Upgradeable to 2400 Baud
- 100% Hayes Compatible—Full Hayes 'AT' Command Set
- Asynchronous and Synchronous Data Formats
- 300/1200 Baud Rates and Auto Dial/Auto Answer
- External RS-232 or Internal Halfcard Models
- FREE Powerful Communications Software and Extras
- Single Modem Chip Technology
- One Year Warranty

Dealer inquiries welcome—for orders or literature call:
Toll free (800)334-5255 Inside CA (818)709-6581

Aicon SYSTEMS

Aicon Systems, Inc. 8968 Fullbright Ave., Chatsworth, CA 91311-6158

35 multiply/add operations be performed simultaneously (see photo 7). The VLSI chip uses a pipeline architecture so that each component performs certain functions and passes its intermediate results to the next component. Nathan estimates that the chip can enhance images 50 to 1000 times faster than present computers and perform filtering operations faster than a Cray supercomputer.

Nathan's VLSI chip was first used on the images from Voyager 2, which completed its encounter with Uranus and its moons in January 1986 and will rendezvous with Neptune in 1989. The spectacular pictures of the Uranian moons transmitted from the far-flung Voyager 2 were filtered and enhanced in a fraction of the time formerly necessary, thanks to Nathan's VLSI chip (see photo 8).

The chip will get a workout from future missions, such as Galileo, which will orbit the giant planet Jupiter for two years and send a probe down into the planet's crushing atmosphere; Mars Observer, which will undertake a thorough mapping of the Martian surface; and Magellan, which will pierce Venus's thick cloud cover and return detailed radar images of the surface.

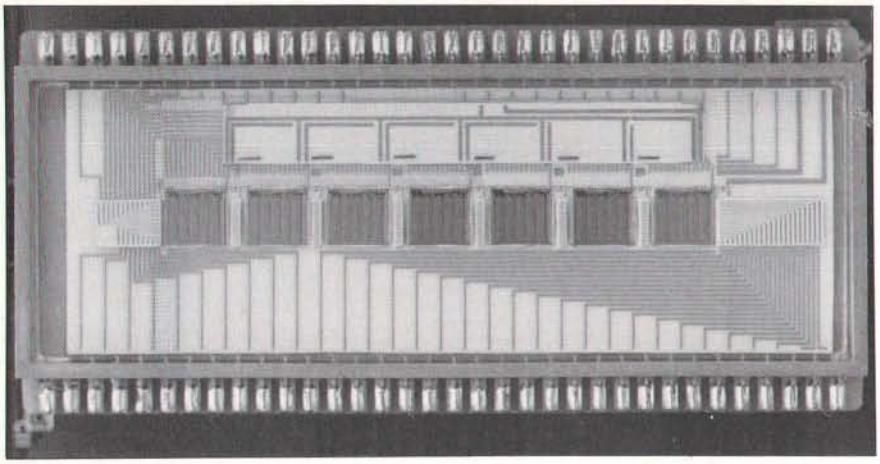


Photo 7: *A hybrid carrier designed by Dr. Robert Nathan holds five VLSI chips and allows up to 35 simultaneous multiply/add operations to be performed on image data.*

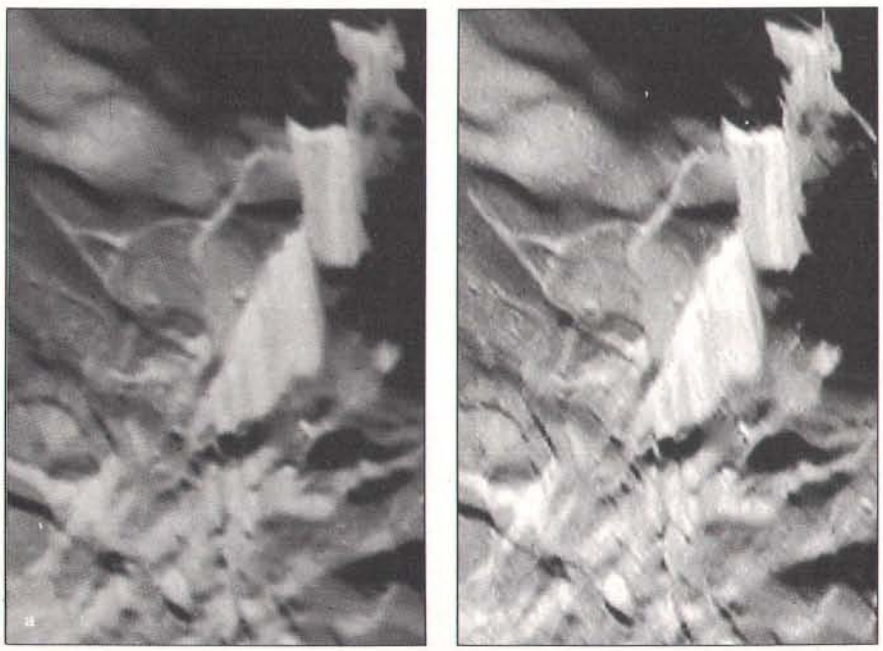


Photo 8: *Miranda, the smallest moon of Uranus identified before the flight of Voyager 2, is a 300-kilometer frozen ball of tortuously twisted rock. These Voyager images of Miranda, shown before (a) and after (b) enhancement by Dr. Robert Nathan's VLSI image processing chip, show cliffs that are approximately 20 kilometers (more than 12 miles) high.*

The Shape of Things to Come

As NASA probes explore the further reaches of this solar system and deep space beyond it, they encounter a number of obstacles. The light from the sun is dimmer, the signals that the probes send back are weaker, and the rate at which they send the signals must be slowed to distinguish the data from the background noise of space. The longer that signals take to pass back and forth from Earth to the probes, the less flexibility researchers have in taking photographs. By the time an image reaches Earth and a course correction can be beamed back to the probe, 30 to 90 minutes might have passed, even though the beam is traveling at the speed of light.

One way to rectify this problem is to apply the sciences of image understanding and artificial intelligence, providing the probes with the ability to decide for themselves what to photograph, what to send back to Earth, and what to ignore.

Such technology has been proposed for the Martian Rover, an unmanned robot that would explore the surface of Mars, take soil samples, map the terrain, and so on. Since the distance to Mars would make remote control of the Rover difficult, if not impossible—by the time you told it what to do, the Rover could fall into a hole or off a mile-high cliff—the use of image understanding and machine vision technology would be crucial to its success.

Since 1985, JPL researchers have been developing a Programmable Image Feature Extractor (PIFEX) system that would perform 10^{11} operations per second on 12-bit data and endow the Rover with real-time machine vision.

One Step Beyond

The theories and technologies behind image processing were in use before their advent at JPL. One-dimensional signal processing was a mature science, having been used extensively during World War II to clean up radar signals. Linear system theory was well known in applied mathematics. The makers of page readers were working in the areas of optical character recognition. And researchers in chromosome analysis had experimented with image analysis and pattern recognition as early as the 1960s. However, the scientists of JPL pulled those technologies together into a new science that has provided never-before-seen views of creation, from the elemental worlds of the atom, to hidden areas within the human body, to the farthest reaches of the solar system and beyond. ■

Now the best is twice as good.

How could anything be twice as good as the Norton Utilities™?

Good question.

After all, the Norton Utilities is far and away the best-selling program of its kind in the world.

Its remarkable UnErase™ feature has rescued the data—and the derriers—of thousands of grateful PC users.

While its passel of popular disk management programs is about the most useful thing to happen to PCs since MS/DOS.

So what could possibly be better than the Norton Utilities?

Better than ever.

Well, for starters there's the Norton Utilities Version 4.0.

It works all the same time-saving and data-saving wonders of our earlier versions—many of them three to five times faster than before.

It also performs several entirely new functions that are worth the price of the program all by themselves.

Like the unique *File Info* which lets you attach descriptions of up to 65 characters to your files.

(That is, if you can think of one that long.)

The new *Norton Integrator* lets you control every single Utility from a single program, and gives you on-line help for each function.

While the new user interface makes the Utilities so quick and easy to run it's ridiculous.



Better yet.

All of which brings us to the new Advanced Edition of the Utilities.

Because the Advanced Edition contains all of the features, functions and enhancements of Version 4.0.

Along with a wish list of technical features and functions sufficient to satisfy the yearnings of all those customers who've been politely writing and calling to request them.

Like *Speed Disk,* for tightening up disk space and optimizing access.

Like *Format Recovery,* for unformatting your accidentally reformatted hard disk.

And *Erase Protect,* for resurrecting lost data days, or even years after the fact.

If you're so inclined, you can explore absolute disk sectors, edit file directories, even attack the FAT table.

And, for the first time, get the upper hand on your hard disk's partition table.

Which of the new Norton Utilities is best for you is up to you, of course.

But one thing's for sure.

Either way, you'll get the best of Peter Norton.

Peter Norton
COMPUTING

Designed for the IBM® PC, PC-AT and DOS compatibles. Available at most software dealers, or direct from Peter Norton Computing, Inc., 2210 Wilshire Blvd. #186, Santa Monica, CA 90403. 213-453-2361. Visa and Mastercard welcome. ©1987 Peter Norton Computing.



DO NOT ATTEMPT WITHOUT COMPUSERVE.

Get all the facts as fast as the experts do before you try to tame the market.

Without accurate, up-to-the-minute data you can easily get taken for a ride on Wall Street. That's why it's important to get your hands on CompuServe. The fastest, most reliable source of comprehensive financial data available.

Now, just like Wall Street's most prestigious firms, you can check out a tip or find a hot, money-making lead in a matter of seconds. Investigate any area of interest. Or scan CompuServe's financial news highlights to find new areas to investigate. Including...

Continuously updated quotes on over 10,000 issues.

MicroQuote II—12 years of daily historical prices, along with dividends, splits, distributions and interest payments on more than 90,000 stocks, bonds, mutual funds, options, foreign exchange rates and hundreds of market indexes.

Graph trends quickly online. Review your portfolio performance, investigate returns in bull and bear markets. Screen for stocks to buy, or transfer prices and dividends to your microcomputer for detailed analysis.

Standard & Poor's descriptive information on over 3,000 companies.

Value Line Data Base II—extensive, fundamental data for analyzing the performances of over 1,800 major corporations.

Disclosure II—descriptive and financial information from the SEC filings and annual reports of over 8,500 companies.

Institutional Broker's Estimate System (I/B/E/S)—earnings projections from top research analysts on over 3,000 widely followed companies.

You can also research technical market trends, review economic projections and high-powered market analyses. Get expert advice on retirement, financial planning, managed accounts, taxes and insurance. Evaluate your own portfolio, even connect to a variety of at-home banking and brokerage services.

And all this comes with CompuServe's base of news, weather, telecommunications, special interest and entertainment services.

Compare CompuServe's rates to the cost of expensive floppy-based sources. Compare our up-to-the-minute delivery to time-consuming publication research. Compare the depth and breadth of our virtually infinite databases to any other source of investment information.

Then see your nearest computer dealer for a CompuServe Subscription Kit. Suggested retail price is only $39.95 and includes $25 of online time.

For more information or to order direct, call or write:

CompuServe®

Information Services
P.O. Box 20212
5000 Arlington Centre Blvd.
Columbus, OH 43220

800-848-8199

In Ohio, call 614-457-0802



An H&R Block Company

Inquiry 66

Digital Image Processing in Art Conservation

New technology reveals secrets in classic works of art

John F. Asmus

MOST OF THE ARTISTIC legacy that resides in the world's museums is visual art such as paintings, drawings, prints, and etchings, or three-dimensional objects that have been carved or shaped, as in the case of statuary. Very little of this material still looks as it did when originally created by the artist or artisan. Paints fade and varnishes darken with time and exposure to heat and light. Chemical reactions take place between the artwork and its environment; the artwork may have been submerged in the sea, buried in the earth, or simply exposed to clean or polluted air. In many instances deliberate or accidental mishandling has caused damage, and in others the original artist, later artists, or restorers have covered over or modified the original subject.

Art conservationists analyze, interpret, and treat maladies that befall ancient works. Some common treatments include revarnishing and relining paintings, mending broken pottery and ceramics, and arresting corrosion on metal artifacts. A complete listing of the artworks and problems encountered in conservation is nearly endless, ranging from woven baskets to the Taj Mahal and from mildew to lipstick graffiti.

Technical developments of the past few decades have triggered a sequence of revolutions in art conservation and in allied disciplines such as archaeology, art history, and anthropology. Information and understanding in these fields have mushroomed as scientific and technical methodologies and tools have been introduced. Nondestructive internal analyses with x-rays and radiocarbon dating were adopted very early in these fields. Subsequently, the list of analytical aids has lengthened to include x-ray fluorescence, scanning electron microscopy, gas chromatography/mass spectrography, and neutron radiography. It extends even further to include photoacoustic spectroscopy, scanning transmission electron microscopy, trace element and various isotopic ratios, thermoluminescence, laser microprobe, and many more. The result has been to provide a scholarly foundation based on objective rather than subjective analyses.

In art restoration these innovations help distinguish authentic portions of the artwork (to be preserved) from earlier restoration materials (to be removed). Visualization of the subject's interior sometimes reveals structural problems, the artist's creative process, an underlying earlier work of art, or the artistic techniques of that era. Consequently, it should come as no surprise that one of the most widespread diagnostics in art restoration is the x-ray, just as it is in many other fields (e.g., medicine).

On the other hand, surface form, color, and texture are key features of most visual art. Inspection and understanding of these characteristics are more germane to the essence of visual art than are esoteric analytic measurements. Art conservationists use the human eye, the optical microscope, and the camera much more than even the venerable x-ray. Thus, visual inspection aids are most likely to be of direct relevance to the tasks associated with art conservation.

Digital computer image enhancement has proven highly useful in numerous fields. Remote sensing, astronomy, and medical diagnostics in particular have experienced quantum leaps in performance through the introduction of this technology. Art conservation also is beginning to benefit from the exploitation of these methodologies.

Beginning with Leonardo da Vinci

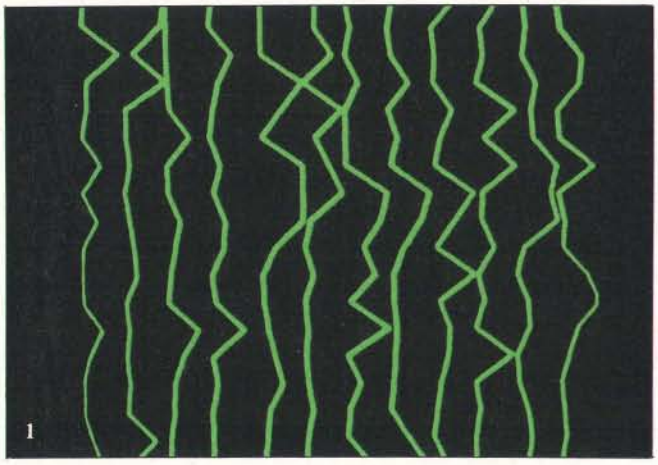
The marriage of image enhancement and conservation began, fittingly, with a work from history's greatest mediator between art and science, Leonardo da Vinci.

In the years preceding 1500, Leonardo had been employed in the service of Duke Ludovico of Milan. In addition to his duties as a military and civil engineer, court painter, and producer of entertainment spectaculars, he executed the famous *Last Supper* mural for the Dominican church of Santa Maria delle Grazie. This led the emerging city-state superpower of Florence to hire Leonardo to paint an even grander mural to decorate its legislative chamber, the Hall of the Five Hundred in Florence's Palazzo Vecchio.

Unhappily, Leonardo encountered technical difficulties with his paints and political problems with his sponsors. His greatest commission, the *Battle of Anghiari* mural, was left unfinished. The Florentine Republic fell in battle and subsequently from power. Giorgio Vasari, art-

continued

John F. Asmus (Institute for Pure and Applied Sciences, University of California at San Diego, La Jolla, CA 92093) is a research physicist.



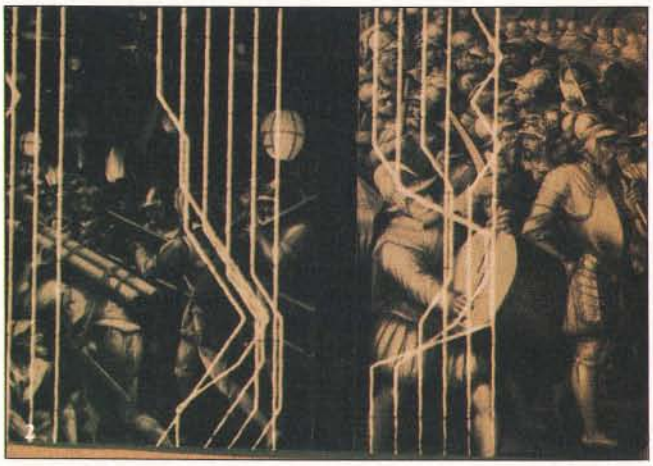




Photo 1: *Unenhanced ultrasonic C-scan image from the east wall of the Palazzo Vecchio showing the inhomogeneous nature of the masonry structure.*

Photo 2: *An averaged ultrasonic C-scan image from the Palazzo Vecchio showing a coherent internal stratum, possibly related to Leonardo da Vinci's long-lost* Battle of Anghiari *mural.*

Photo 3: *X-ray image of a Rembrandt painting showing the overlap of the two heads from the underlying and surface paintings, respectively. (Courtesy J. Twilley.)*

ist of the Medici regime that followed, repainted the walls of the chamber with his own murals, depicting military victories that glorified the new rulers. Vasari rewrote history and the Leonardo painting was never again seen.

In 1975, the city of Florence invited my organization, the University of California at San Diego Project for Art/Science Studies, to search for the remains of the Leonardo mural. During the preceding decades historical evidence had been accumulating that Vasari might not have destroyed Leonardo's work but simply covered it over before repainting the hall. My organization's commission was to develop a nonintrusive technique to "look" beneath the hundreds of square meters of Vasari wall paintings for a deeper stratum of a few square meters that had been executed by Leonardo. Once located, the Leonardo work could be removed for display without disturbing the Vasari paintings by, for example, quarrying the palace wall from behind.

We considered searching with thermovision, x-rays, neutron activation, electrical conductivity, and microwaves. Finally, following analyses and laboratory simulations, we chose ultrasonic echolocation (similar to sonar).

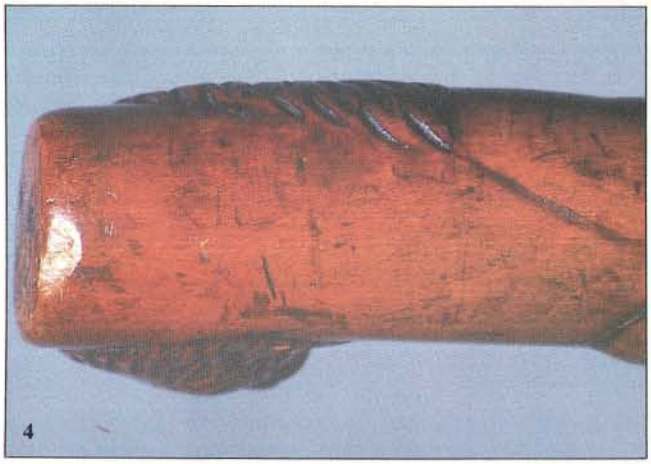
Throughout 1976 and 1977, we recorded tens of thousands of ultrasonic echoes for a carrier frequency of 1 megahertz across the surfaces of the Vasari wall paintings in the Hall of the Five Hundred (see reference 1). The masonry materials of the palace walls consist of brick, stone, and mortar and are highly inhomogeneous, so these ultrasonic records were extremely noisy. Photo 1 shows a typical unprocessed ultrasonic C-scan image of the interior of the wall. (A C-scan is a two-dimensional image of the ultrasonic echo return intensity from a particular depth or range.) Such records could contain evidence of a flat "island" of paint embedded within the palace wall.

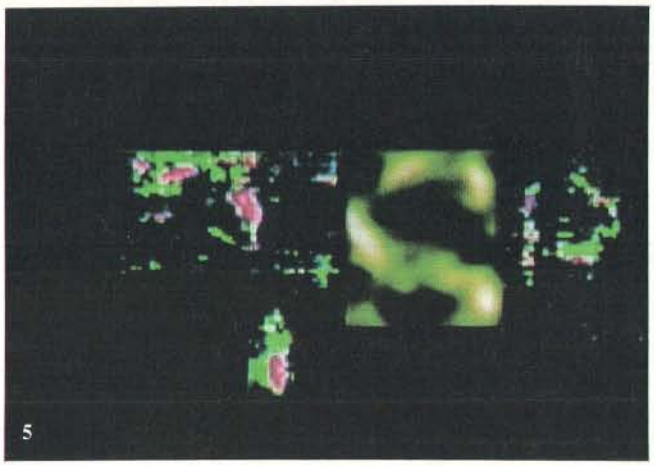
The break came in early 1977 when my research team began digital image processing of the C-scan ultrasonic images. We realized that the signals from the random inhomogeneities of the masonry materials would be spatially incoherent. To combat this, we divided the wall into a grid of lines 1 foot apart. We then took ten readings near (but not exactly on) each intersection of the lines and averaged the readings for that point. Thus, we hoped to improve the signal-to-noise ratio and allow the coherent return from any extended subsurface structure (such as a walled-in painting) to emerge.

In fact, we found this to be the case. As shown in photo 2, we replaced the amplitude of the ultrasonic return from each pixel location by the average of ten ultrasonic returns from the immediate vicinity. The resulting amplitude at each pixel location is represented by the lateral deflection of the scan line; straight vertical lines indicate the absence of any coherent return (and therefore any planar substructure). The entire C-scan has been superimposed on a picture of the Vasari murals at that location. As you can see, a strong contiguous return has emerged in the lower area where the two murals meet. This position is consistent with one of the predicted locations of the Leonardo painting as gleaned from an analysis of historical records. We believe this is the most plausible place to search for the lost Leonardo mural painting.

Clarifying Images

As I mentioned earlier, much of art conservation practice involves the inspection and interpretation of photographs and radiographs. Frequently, an x-ray is made of a painting in order to reveal an earlier composition hidden beneath the one that is visible on the surface. In general, the





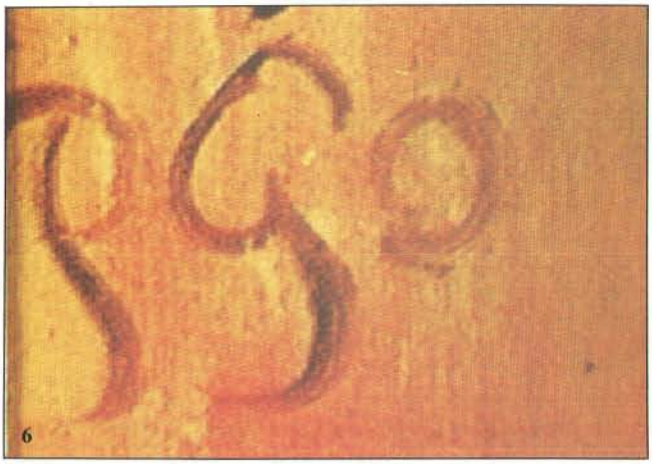


Photo 4: *Handle of a carved Tahitian walking stick. (Courtesy C. Tyler.)*

Photo 5: *Computer-enhanced image of the handle area of the walking stick.*

Photo 6: *A typical signature of the artist Paul Gauguin.*

resulting x-ray image will be a mixture of the surface image, the underpainting image, and the x-ray transmission properties of the support structure (canvas or wood). The x-ray of a Rembrandt painting shown in photo 3 reveals such multiple features.

A group headed by J. R. Druzik, after unsuccessfully trying pixel averaging on an x-ray of a Jan Erasmus Quellinus painting, found that fast Fourier transform filtering removed a quasi-periodic woodgrain pattern quite effectively (see reference 2). They then proceeded to subtract a gray-level-processed image of the top painting from the filtered and gray-level-processed x-ray, to obtain a clearer image of the underlying painting.

With the completion of the ultrasonic image processing for the *Battle of Anghiari* search, my UCSD group concentrated on clarifying inscriptions and drawings. These projects used the same operations that the Druzik group independently applied to radiographs.

A typical problem involved the hand-carved wooden walking stick shown in photo 4. The object's owner noticed that the handle bore some faint traces of scratches that appeared to have been largely worn away through use. On the assumption that the scratches may have been the remains of an inscription, we digitized (300 by 400 pixels) the central portion of the image in photo 4. To remove the visual interference of the wood grain, we then applied FFT filtering, followed by a 5- by 5-pixel averaging to partially fill breaks in the lines. Finally, line-by-line averaging and differencing leveled the effect of the curvature of the shaft on the image intensity.

The results of these operations are presented in photo 5, which suggests that the scratches are the remains of three letters. Since the cane was from Tahiti, longtime workplace of the artist Paul Gauguin, we compared this three-figure pattern with Gauguin's signature (see photo 6). Considering that the former was carved in wood and the latter painted, the similarity is striking. Further, Gauguin's ill health caused him to use a cane toward the end of his life. This type of evidence certainly does not prove that this stick was carved by Gauguin, but it does suggest moving on to physical tests to determine the age of the wood and its type.

Paintings and the Whole Moon Catalog

I have thus far discussed images that are essentially single-banded or monochromatic. Such images represent the mere tip of the iceberg: The vast majority of museum artifacts are polychromatic. On the other hand, color image processing is considerably more challenging than monochromatic image processing. Not only do full-color images involve three simultaneous bands (red, green, and blue), but the issues of saturation, hue, and visual perception also come into play.

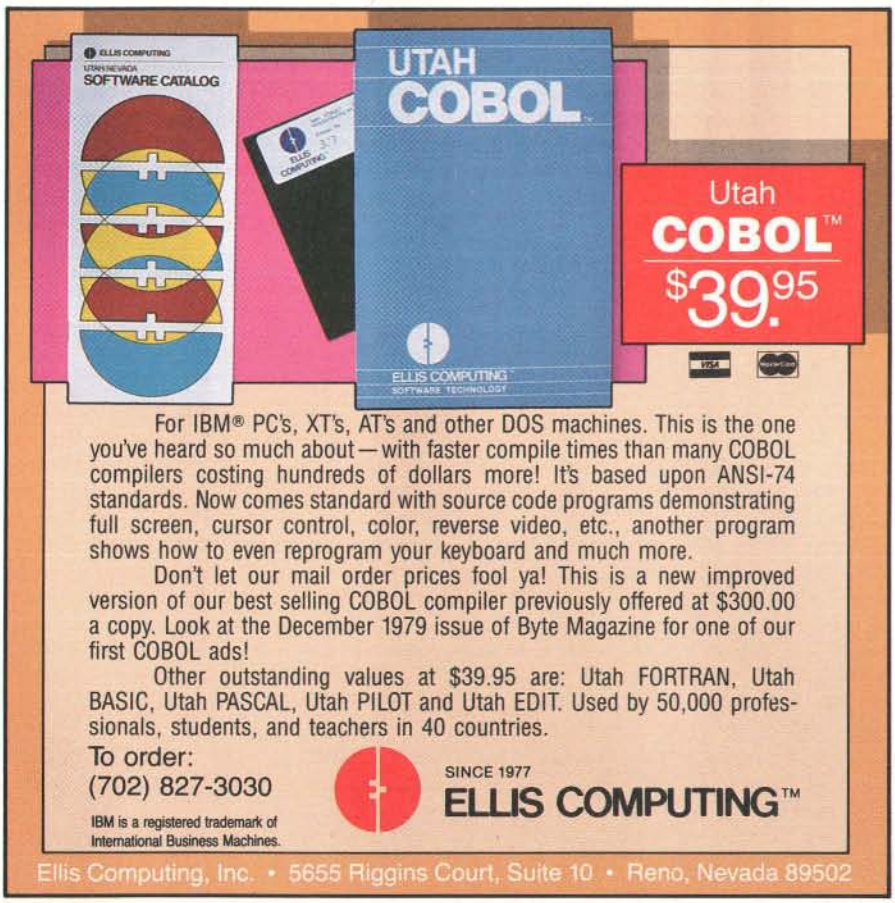
In 1974 a group of moon watchers assembled and formed the La Jolla Consortium to coordinate the diverse efforts aimed at producing a "Whole Moon Catalog" from the body of remote sensing data that had accumulated. By 1977, consortium members Lawrence Soderblom and Eric Eliason had developed a 32-bit image comparison computer system. In 1978 another member of the group, James Arnold, suggested using the system to recover the original appearances of fine paintings covered by old yellowed varnishes. Toward the end of that year, the first tests of such a technique were performed at the United States Geological Survey Image Processing Center in Flagstaff, Arizona.

The initial subject was a copy of da Vinci's *The Virgin of the Rocks* before and

continued

Inquiry 264





after varnish stripping by D. M. Domergue, a conservator of paintings. We digitized both images and played them back through the Flagstaff system, then attempted, by trial and error, to develop an algorithm to modify the RGB statistics of the varnish-covered image so that it looked like the stripped image. Such an algorithm could then be used to "correct" other paintings.

Unfortunately (for our project), data from the Voyager 2 flyby of Jupiter began coming in to Flagstaff, and we lost access to the system. At that time the Flagstaff system was not interactive. Because of this, discovering the varnish-erasing algorithm would take several passes through the experimental process—each of which had a turnaround time of about 24 hours.

However, other opportunities were at hand. The California Space Institute had been established and an IDIMS (Interactive Digital Image Manipulation System) was installed at our site. The 8-bit 512 by 512 IDIMS image was somewhat of a limitation after the Flagstaff experience, but the interactive capability later became indispensable.

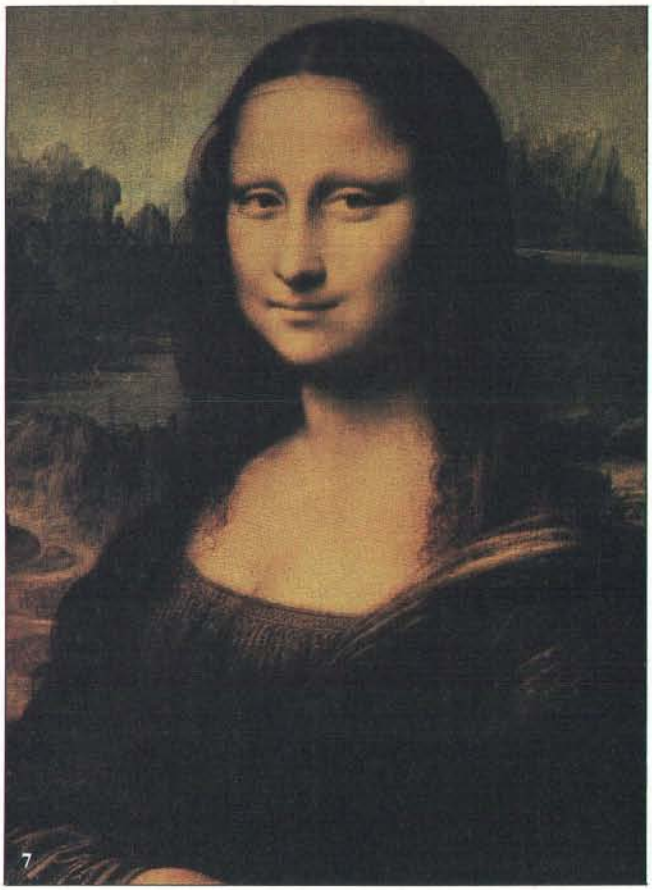
The Mysteries of *La Gioconda*

Probably the most famous and admired painting in Western civilization is Leonardo da Vinci's *Mona Lisa* (or *La Gioconda*) located in the Louvre of Paris. At present, the image of the lady is barely a shadow of its original appearance. It is covered by a thick green-brown varnish with extensive craquelure in both the varnish and paint layers. Lord Kenneth Clark believed that the hands and eyebrows were repainted after 1550 by a restorer (see reference 3). The da Vinci scholar Carlo Pedretti has noted that the darkened lower half of the painting gives the incorrect impression of a thick (possibly pregnant) torso (see reference 4).

Pedretti identified several ambiguities in the *Mona Lisa* that would be suitable topics for our image processing work. He agreed to obtain a high-resolution, large-format color photograph of the painting from the Louvre for digitization. For the next three years we worked sporadically on image processing of inscriptions while awaiting the high-quality photograph of the *Mona Lisa* from the Louvre which was always to be in the mail "next week."

Then, in 1981, Walter Cronkite announced that he wanted to include a segment on our image processing of the *Mona Lisa* in his first "Universe" television program. I explained with regrets that we had no high-quality photograph of the *Mona Lisa* with which to work. Cronkite called the Louvre, and within a week our three-year wait was over.

Inquiry 102



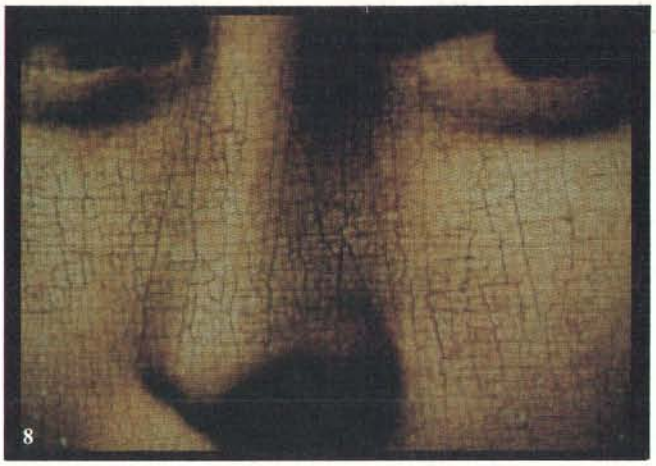


Photo 7: *Leonardo da Vinci's* La Gioconda, *more familiarly known as the* Mona Lisa.

Photo 8: *Detail from the digitized* Mona Lisa *showing the extent of the craquelure, tiny crackle lines in the painting's varnish.*

The photograph of the *Mona Lisa* was digitized at NASA's Jet Propulsion Laboratory into 6 million pixels in each of the three color bands. We then measured the spectral transmission for an ancient varnish specimen believed to be similar to that covering the *Mona Lisa*. For Cronkite's "Universe" program, we deconvolved (subtracted) the varnish spectral transmission from the image: The sky changed from brown to blue, the skin from yellow to alabaster, and the gown gained a deep greenish tint. Finally, an art historian demonstrated the interactive potential for analysis with zooming, panning, and split-screen techniques for comparisons. The main limitation to emerge from that demonstration was the 512 by 512 resolution of the system.

Toward a Perfect *Mona Lisa*

In order to study the *Mona Lisa* further, create an image simulating its original appearance, and evaluate applications of image processing technology in the art restoration field, we have continued our efforts beyond the initial 1981 test (see reference 5).

The original high-resolution large-format color transparency of the *Mona Lisa* acquired from the Louvre measures approximately 10 by 12.5 centimeters. Photo 7 shows the original image. Photo 8 is a close-up of the image revealing the extent of the craquelure.

A scanning microdensitometer with a 0.02-millimeter aperture was used to scan the central portion of the photograph to produce three digital files, one for each primary color (red, green, and blue). Each computer file of digital data contained 2600 scan lines, with 2200 pixels per line. Each pixel carried an integer value in the range 0 to 255 corresponding to the pixel brightness for each of the three primary colors, with 0 representing black and 255 representing the maximum brightness of the color.

The vast amount of digital data generated by scanning the color transparency (2600 by 2200 pixels) could not be handled in a routine fashion. This restricted our analyses to a 1024 by 1024 subimage at full resolution covering the head and neck, and to the full image whose resolution was reduced by a factor of two in each direction. Image analysis and display operations were performed at the IBM Palo Alto Scientific Center using the interactive IBM 7350 Image Processing System (IPS) and the IBM 5080 workstation attached to an IBM 3081 computer. Some of the experimental software used in this investigation was originally developed for processing image data from the earth observation program. Some techniques, such as parallel-piped classification (see reference 6), principal component transformation (see references 7 and 8), and regional enhancements, provided only minimal improvement of the images. Several other approaches, described and illustrated in the following paragraphs, produced significant results.

Color Correction

The information content of image-band data can be represented statistically by a histogram showing the number of pixels versus pixel brightness level. Such histograms rarely exhibit the standard bell-shaped curve of a Gaussian distribution. However, you can compute the mean and standard deviation of the distribution and use these values to generate the slope and the intercept of a line. This line is then used to translate pixel values into gray levels of the primary color specified for the visual display of the band data. You can modify the intensity distribution of the displayed image by adjusting the *y*-axis intercept of the line (i.e., by adding a bias to the translation table).

By measuring the optical absorption of a varnish specimen and determining that it is approximately proportional to the inverse wavelength of light at that color, we were able to make comparable modifica-

continued

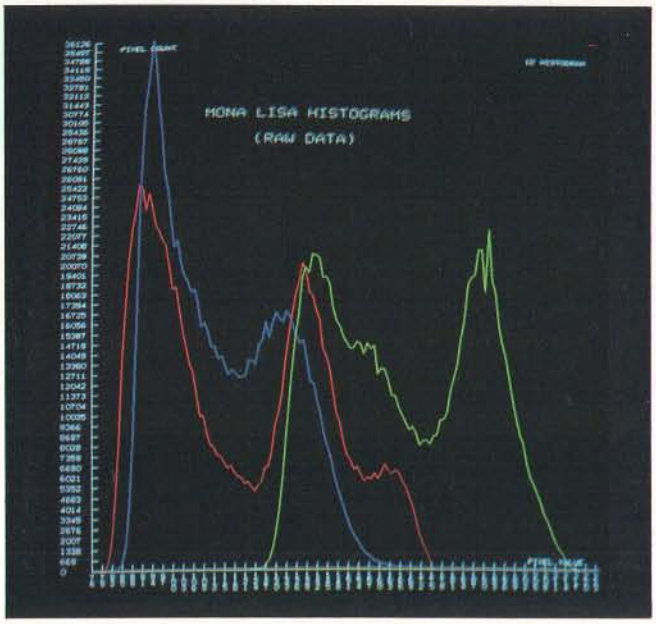


Photo 9: *Pixel histograms for the RGB bands of the digitized* Mona Lisa.

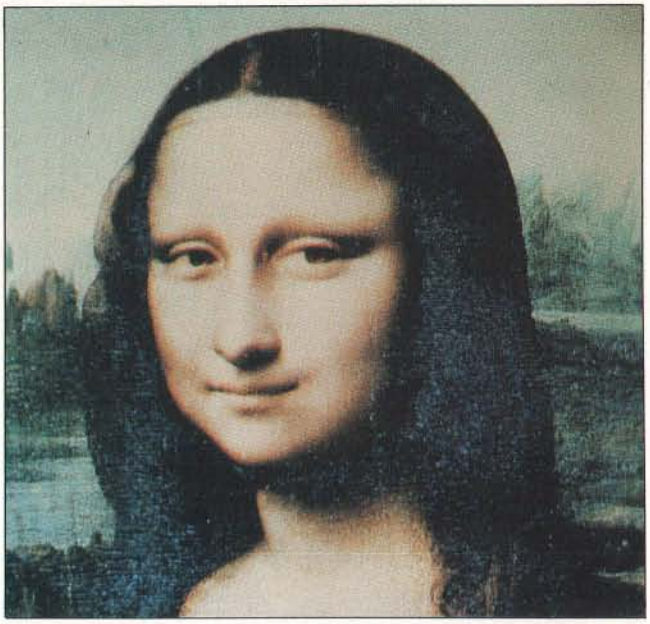


Photo 10: *A photograph of the color-corrected, digitized* Mona Lisa *painting displayed on a 1024 by 1024 color monitor. This procedure yields an image with a normal color rendition, but with a considerable amount of glint in the hair region.*

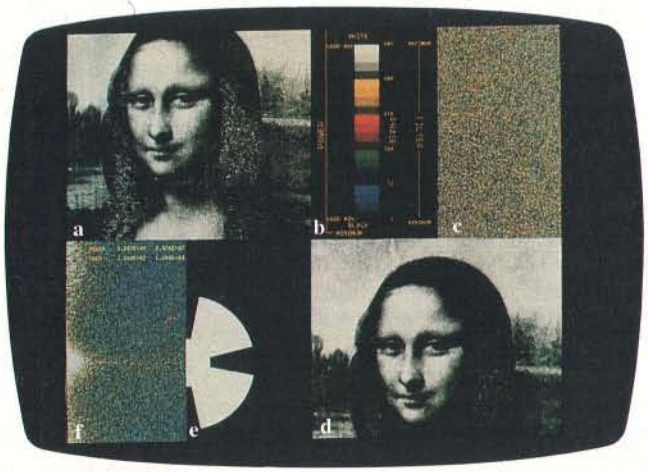


Photo 11: *Frequency-domain characteristics of the head-neck region of the original* Mona Lisa *digitized with a blue filter; also the filter used to reduce the glint. Clockwise from top left: (a) original blue-band digitized image in gray scale; (b) scales used for (c), (e), and (f); (c) phase spectrum image; (d) Fourier filtered blue-band digitized image in gray scale; (e) two-dimensional filter; and (f) power spectrum image.*

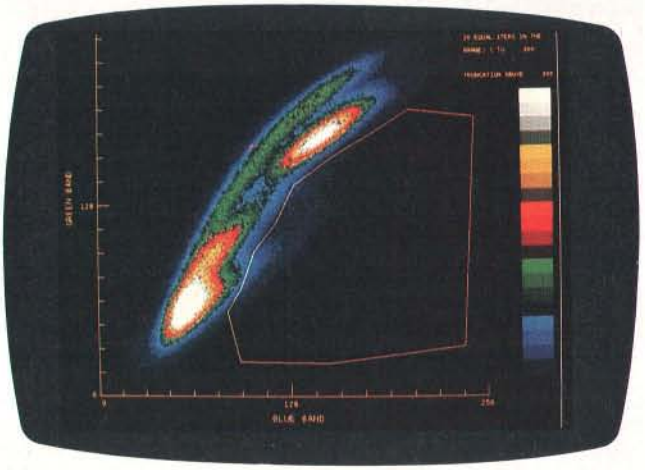


Photo 12: *A bi-scatter plot of pixel values in the head-neck region. Pixels represented by combinations within the polygon are good candidates for data manipulation.*

tions to the biases for the RGB bands (see photo 9). In other words, we calculated the factor by which the varnish attenuated a color, then divided the intensity of each pixel of that color by the attenuation factor—which effectively restored the pixel to its original value. Thus, each blue pixel was divided by 0.4, each green pixel by 0.2, and each red pixel by 1.0 (i.e., left unchanged).

The resulting *Mona Lisa* image is shown in photo 10. Most art professionals who have viewed this transformed image agree that it effectively compensates for the undesirable filtering of the discolored varnish and that the colors are more natural. Unfortunately, the photographic lighting, together with the craquelure, produced a front-surface glint. Under the bias adjustment, the most severe glint is transformed into unsightly blue stripes, primarily in the hair. We chose the next operations to delete this artifact.

Frequency-Domain Filtering

Because the craquelure-induced glint effects are periodic in nature, a plausible approach to their removal was through FFT filtering techniques. This approach generated a two-dimensional matrix

whose complex elements represented the phase and amplitude of various spatial waves responsible for the image. We then developed a two-dimensional filter to attenuate the waves responsible for the glint. Performing the inverse Fourier transformation of the product matrix from the transformed image and the filter yielded an image with reduced glint.

An illustration of this process appears in photo 11. One band of the original image is shown in the top left corner. Phase information contained in the Fourier coefficient matrix appears in the top right, and power information in the bottom left corner. (By "power" I mean strength of response to the fast Fourier transform. Large, low-frequency elements such as the nose and eyes have a strong response, whereas detailed, high-frequency elements like brush marks and craquelure have a weak response.)

Based on the information contained in the power spectrum image, the operator interactively develops a two-dimensional filter by combining wedges and rings, as shown in the second half of the bottom left image. Frequencies falling in the white area are accepted, and those contained within the dark area are suppressed. The inverse Fourier transform of the accepted waves results in the gray-scale image in the bottom right corner. Note the significant reduction of glint in the hair.

Selective Data Manipulation

Another procedure for further reducing the craquelure-induced glint is the selective manipulation of the three-band values of selected pixels—in other words, repainting each pixel of an undesired color to the desired color. Such a simpleminded approach would be subjective, cumbersome, and time-consuming. We approached this problem by analyzing the statistics of the undesirable pixels in a tabular and graphic form. Similar information was also collected concerning the desired values in the same area.

We generated a three-dimensional histogram (bi-scatter plot) representing the number of pixels with a given brightness combination in two bands (blue and green) with the greatest cosmetic defect (see photo 12). A polygon based on the approximate level and range of brightness information was drawn around those values, thereby defining a mask that could be applied to the data. Photo 13 shows the result of applying this operation to the *Mona Lisa* files that had been obtained from the color-correction and FFT operations (compare photo 10). Clearly, the hair glint has been eliminated. An enlargement of the face (see photo 14) also reveals a significant reduction in paint-layer cra-

continued

Inquiry 228

WHAT DO THEY HAVE IN COMMON?

Wizardry · Jack2 · Dollars and Sense · Open Access II

ALL WERE DEVELOPED WITH PECAN'S POWER SYSTEM AND UCSD PASCAL

Join these and many thousands of other successful software developers!
THE POWER SYSTEM: An integrated program development environment

- UCSD Pascal
- Modula-2
- FORTRAN-77
- BASIC
- Assemblers
- Program Development Tools

Available for:
- IBM PC
- Macintosh
- Atari ST
- Amiga
- Apple II
- Others

Power System with your choice of language only $99.95

Mail your check or money order to:
Pecan Software Systems, Inc.
1410 39th Street
Brooklyn, New York 11218
(718) 851-3100
NOT COPY PROTECTED

Please add $4.50 for shipping within the US. Foreign orders add $15.00 and make payment by bank draft payable in US dollars on a US bank. New York State residents add appropriate sales tax.

Dollars and Sense is a trademark of Monogram Software, Inc. Wizardry is a registered trademark of Sir-Tech Software, Inc. Open Access is a registered trademark of Software Products International. Jack2 is a registered trademark of Pecan Software Systems, Inc. UCSD Pascal is a registered trademark of the Regents of the University of California.

PECAN™
The UCSD Pascal Company
Credit card orders
call toll free 1-800-63-PECAN
NYS 1-800-45-PECAN

A CROSSTALK® XVI
SuperKlone™



FEATURING
Foreground/Background Communications

MIRROR™ provides:
- Crosstalk XVI compatibility
- Background communications
- Built-in text editor
- Learn-mode for automatic script file generation
- Transaction log

AND MUCH MORE...

SOFTKLONE™
1210 E. Park Ave. • Tallahassee, FL 32301
For information call 1-904-878-8564
TLX: 6714280 KLON
The Age of KloneWare Has Arrived

Shipping/handling 5.00
(COD orders add $3.00)
International shipping/handling 18.00
Florida residents must add 5% sales tax

VISA · MasterCard · COD
To Order Call (904) 878-8564

MIRROR™ $69.95
Site Licensing Available
60-Day Money-back Guarantee
Not Copy Protected

Distributed in Canada by:
Saraguay Software Distributors
Telephone: (416) 923-1500

Distributed in Scandinavia by:
UNIC, (Norway)
Telephone: 02 38 39 10

Distributed in the UK by:
Management Data Processing Ltd.
Telephone: (0225) 60494
Trisoft Ltd. Telephone: (0629) 3021

Distributed in Australia by:
Delta Computer Systems Pty. Ltd.
Telephone: (02) 633-4055
P.C. Extras Pty. Ltd.
Telephone: (02) 319-2155

MIRROR is available for the IBM PC/XT/AT and compatibles running MS-DOS 2.0 or higher. MIRROR™, SuperKlone, KloneWare and SoftKlone are trademarks of SoftKlone Distributing Corporation. Crosstalk XVI and Microstuf are registered trademarks of Microstuf, Inc.

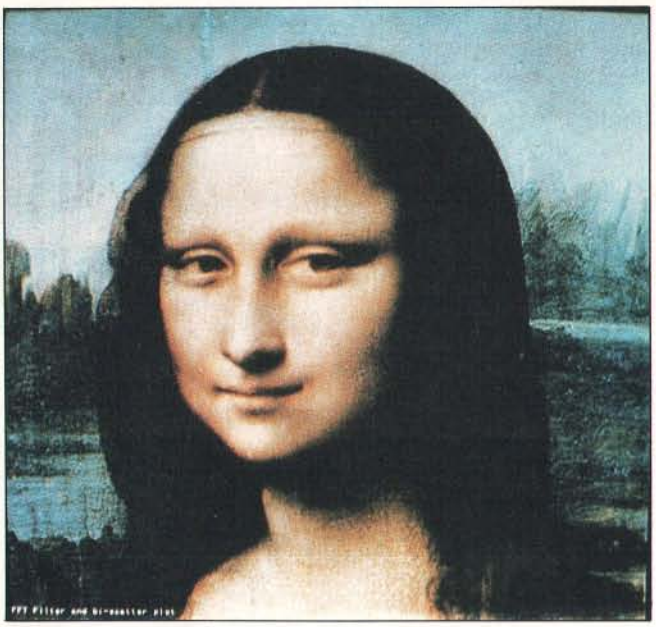


Photo 13: *This image shows the* Mona Lisa *following frequency-domain filtering, color correction, and correction using the bi-scatter plot of photo 12 and a mask. An obvious decrease in glint is evident, especially in the hair (compare with photo 10).*

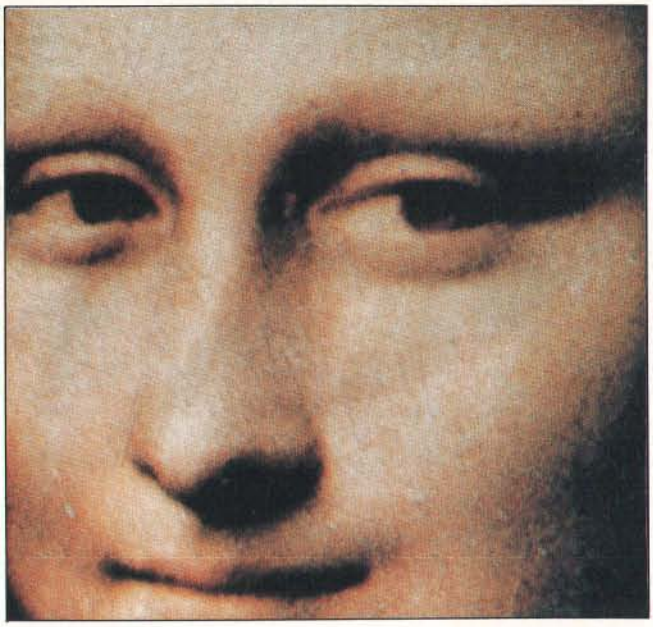


Photo 14: *An enlargement of a portion of photo 13, showing the significant reduction in craquelure effect (compare with photo 8).*

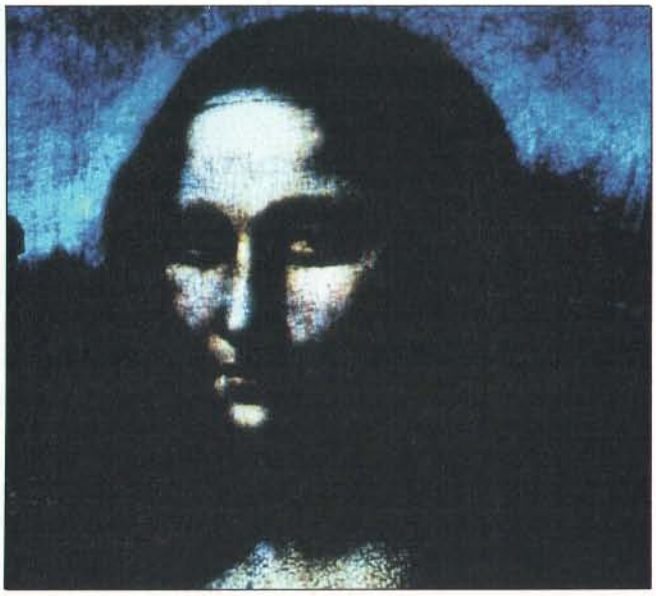


Photo 15: *The digital data from the* Mona Lisa, *as modified by the regional-contrast-enhancement and histogram-equalization procedures.*

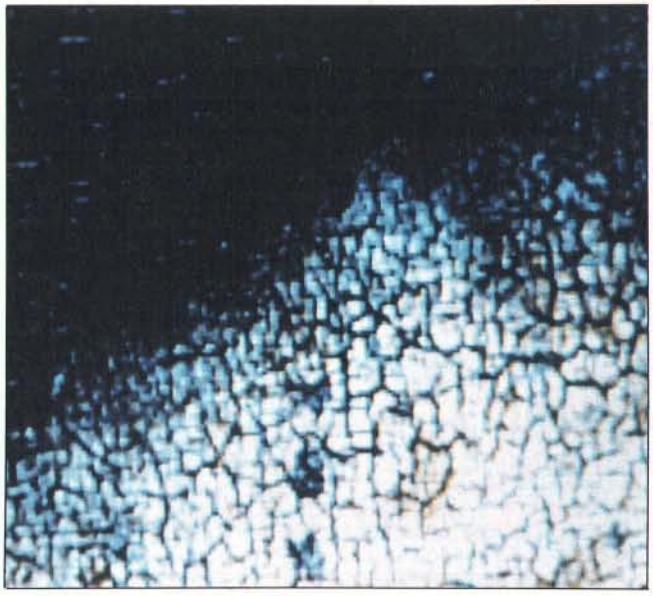


Photo 16: *This enlargement of the false-color image in photo 15 shows a series of dots that may be part of a neck adornment.*

quelure compared to that of photo 8. The sequential application of these three transformations illustrates how this painting has changed through the years.

The Necklace and the Overhang

A not-too-surprising occurrence accompanied the first viewings of the corrected *Mona Lisa*. Some noticed the faint outline of a necklace. This pattern included three or four equally spaced and distinct dark spots. Others saw a faint ridge-like mountainous structure within the mountain gap to the viewer's left of the sitter's right eye.

The revelation of new details caused by lifting the dark veil from the image should not be surprising, but it raises a perplexing question: Were these artifacts part of Leonardo's original composition; changes made by him; the result of restorations, damage, or deterioration; or simply a Rorschach phenomenon? We have sought to explore this issue through the application of still other image processing operations.

Regional Contrast Stretching

An image feature that has been painted over or removed by chemical or abrasive

methods may manifest itself as subtle intensity variations. To enhance such indicators, we performed a regional contrast stretch. We selected a region for intensity enhancement and computed the statistics of that region in the three bands. The statistics were then used to perform a "histogram equalization" of the entire image. The result is to "stretch" the intensities in the region of interest so that the full dynamic range of the display device could be used to analyze that region. Clearly, other parts of the image would be degraded. Photo 15 shows such an enhancement based on the statistics of the neck region. The enlargement of the lower neck shown in photo 16 reveals the geometrical structure of these "necklace beads."

Local Intensity Enhancement

The standard edge-enhancement procedure, based on the double-differentiation Laplacian operator on a 5 by 5 area, could be used to bring out further details. A better procedure is the one commonly referred to as local intensity enhancement. Under this procedure a new pixel value is computed from the mean and standard deviation of the pixels in a square surrounding it and from a desired mean and standard deviation for the entire image. We used a 31- by 31-pixel square for computing the local statistics. After several trials, we selected intensity count values of 128 and 20 for the desired mean and standard deviation, respectively.

Photos 17 and 18 show the result of applying this procedure to data in all three color bands. Careful inspection reveals a number of interesting features. Most dramatic is a modulation in the craquelure intensity. Virtually every important outline exhibits a smooth border as if some restorer had either touched up or overcleaned the outlines. The suspected necklace beads also appear. Finally, you can see that the lady is smaller than her outline. Note that the starchy veil is lifted above both her hair and the upper arm on her left (our right).

Level-Slicing Operations

One class of image processing operations involves grouping small ranges of pixel levels and arbitrarily assigning them a display color (pseudocoloring) or shade of gray (gray-level mapping). We applied this technique to the blue band of the image and noted an interesting structure in the mountain gap to the left of the figure's right eye. An enlargement of this area (see photo 19) shows a contour and structure resembling a continuation of the mountains into the gap. Compare this to photo 20, an edge-enhanced version of the

continued

Hogan! How did you get your own parking space?



BYTE readers influence microcomputer purchases at their company. And, according to MRI's Spring Study, there are more than 600,000 of them. Advertise to BYTE readers like Hogan and they'll do the rest.

BYTE means business.
BYTE
THE SMALL SYSTEMS JOURNAL
One Phoenix Mill Lane
Peterborough, NH 03458
(603) 924-9281

Bus Specific Networks

NEW ADD-ON-AND-ON

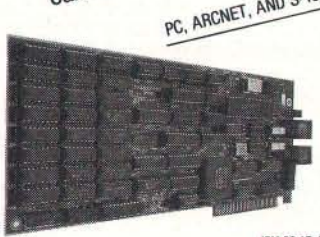
Improve your "low-cost expansion/add-on performance ratio" now with ICM's new CPS-PC Slave Cards.

Now you can have multiprocessor architecture on stand-alone IBM PCs, fileservers and compatibles. Simply add the new CPS-PC Slave Card from InterContinental Microsystems and a PC terminal to your XT or AT expansion bus, and you've added a PC.

For every CPS-PC card and terminal you add, you get another PC for more network users without a LAN hookup. Our CPS-PC slave cards also save space, install easier, reduce noise, reduce heat, reduce maintenance and repair costs, are easier to integrate and perform twice as fast as an IBM PC or XT.

Call ICM for more information and reseller pricing.

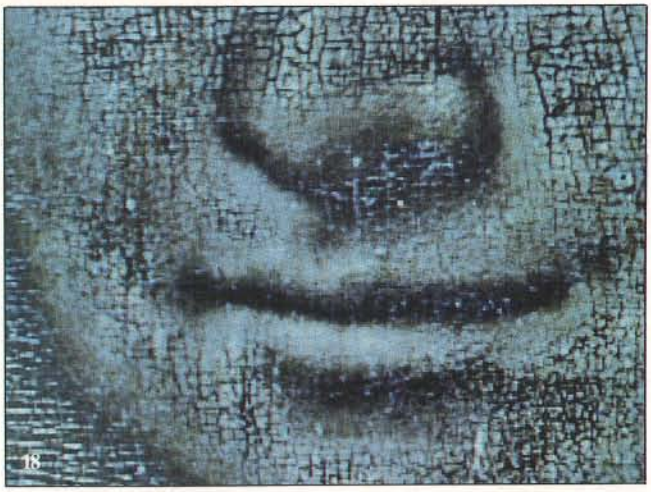
PC, ARCNET, AND S-100 APPLICATIONS



ICM
TOMORROW'S BREAKTHROUGHS TODAY
InterContinental Microsystems
4015 Leaverton Court, Anaheim, CA 92807
Phone: (714) 630-0964
Telex: 821375 SUPPORT UD
Easylink: 62562040 BBS (714) 632-8750

IBM PC-AT, IBM PC-XT, IBM PC, and PC-DOS, are registered trademarks of International Business Machines Corp. MS-DOS is a registered trademark of Microsoft Corp. TurboDOS/PC is a registered trademark of Software 2000 Corp. ARCnet is registered trademark of Standard Microsystems Corp.







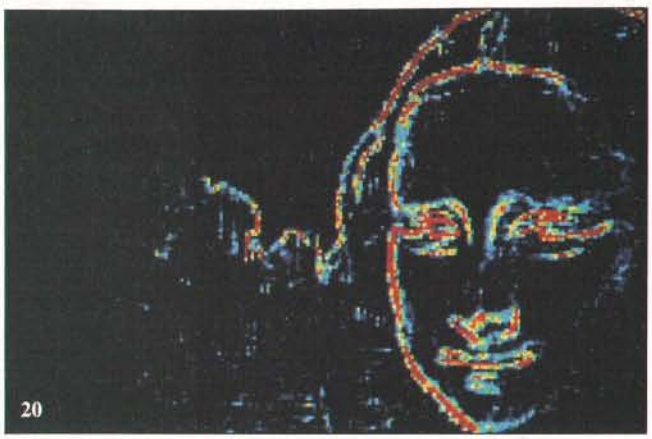


Photo 17: *The digital data from the* Mona Lisa *(linearly reduced by a factor of 2) as processed by a local-intensity-enhancement algorithm. The unexpected smooth zones follow major outlines of the painting and may indicate the work of a restorer.*

Photo 18: *An enlargement of a portion of photo 17, revealing possible restoration around the mouth.*

Photo 19: *A pseudocolor transformation of the blue band of the* Mona Lisa *image shows evidence of a possible mountain ridge or steep, hollow basin to the left of the figure's right eye.*

Photo 20: *An edge-enhanced version of the* Mona Lisa *isolates the contour of the gap to the left of the eye. Compare this with the structure revealed in photo 19.*

original image that isolates the contour of the gap as seen by the eye.

History and Speculation

When an artist executes a painting, changes are frequently made by painting over earlier portions of the composition. With aging, such underlying patterns begin to show through and are known as *pentimenti*. This could be the case with the dark spots revealed below the sitter's neck, which resemble the beads of a necklace. These spots do not appear to be related to damage; the major structural problem of the panel (a vertical crack visible above the head in photo 13) is several centimeters to the left of the spots.

Further, there are reasons for believing that Leonardo may have begun the work with a necklace. The first concerns the relationship between the *Mona Lisa* and Raphael's painting *La Muta* (see photo 21). Many scholars contend that numerous similarities between the paintings indicate that Raphael gained inspiration from an early viewing of the *Mona Lisa* around

continued

SYNC TWICE.

MULTISYNC™ SETS ANOTHER INDUSTRY STANDARD WITH A GRAPHICS BOARD THAT OFFERS PGA RESOLUTION AT AN EGA PRICE.

Another standard from MultiSync.™ First, the MultiSync monitor, the original color monitor compatible with CGA, EGA, and PGA graphics adapters.

Now, the new MultiSync GB-1 graphics board.

With a MultiSync monitor, the GB-1 actually takes EGA all the way to PGA resolution—640 X 480!

Compatibility is no problem. The GB-1 syncs with EGA and CGA color text and graphics, and with MDA and Hercules™ monochrome.



Built-in screen drivers ready for 1-2-3,™ Windows,™ AUTOCAD,™ Dr. Halo II.™

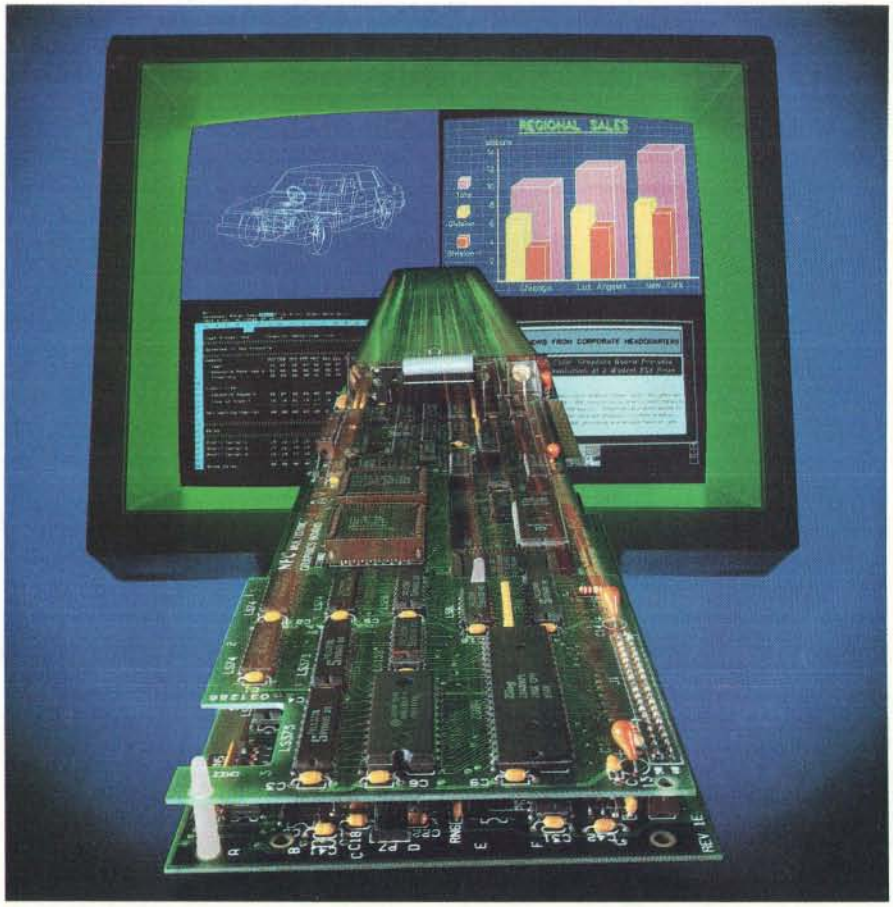
So you're ready for the top spreadsheet, window and CAD/CAM programs in ultra high resolution, without investing in more boards. Even a parallel printer port is included.

Free Dr. Halo II software.

This powerful program provides dramatic color for business graphics. With smoother scrolling, Hardware Zoom. Hardware Viewport. And pixel panning.

Desktop publishing comes true.

When you create graphics for business presentations, your free Dr. Halo II software works like a paint brush. Just pick your palette, and work in the clearest colors. It accommodates a wide assortment of type fonts, too.



MULTISYNC™

COLOR GRAPHICS BOARD

132 column spreadsheets.

You can display up to 132 columns by 44 lines. With text, your screen will show nearly a full page.

$50 Rebate!

Purchase a MultiSync Color Graphics Board and you'll find a $50 rebate coupon inside the carton. You can apply it to the price of the MultiSync Color Graphics board or the 14" MultiSync Color Monitor.

See your MultiSync dealer. He has the graphics board and the monitor that will open your eyes. Your computer's too.

For product information and sales assistance, call 1-800-447-4700.

For technical assistance and information, call 1-800-NEC-SOFT.

NEC Home Electronics (U.S.A.) Inc.
Computer Products Division
1255 Michael Drive
Wood Dale, Illinois 60191.

NEC

C&C Computers and Communications

MultiSync is a registered trademark of NEC Home Electronics (U.S.A.) Inc. 1-2-3 is a registered trademark of Lotus Development Corp. Windows is a registered trademark of Microsoft Corporation. AUTOCAD is a registered trademark of Autodesk, Inc. Hercules is a registered trademark of Hercules Computer Technologies. Dr. Halo II is a registered trademark of Media Cybernetics, Inc.



Photo 21: *Raphael's painting* La Muta, *believed to have been inspired by his early viewing of the* Mona Lisa, *which may once have worn a necklace of beads similar to* La Muta's.



Photo 22: *The office of the vice president of the United States, in the Old Executive Office Building. Image processing of present-day photographs and 19th-century images of stencils on the walls is helping to restore the room to its original condition.*



Photo 23: *An image-processed ice-age French cave painting.*

1505. There is the remarkable coincidence that the spots lie precisely on the vertical bisector of the face just as in the case of the left side of *La Muta*'s adornment. A survey of Leonardo's paintings reveals that figures in those predating the *Mona Lisa* have neck adornments, while figures in the later paintings do not. This finding raises the possibility that Leonardo began simplifying his style during, rather than before, the *Mona Lisa* work.

The Mountain Gap

As illustrated by photo 19, the image processing operations brought out a suggestion of a mountain ridge or a steep hollow spanning the mountain gap to the left of the lady's head. This makes a great deal of sense. Most of Leonardo's paintings have range upon range of mountains fading off into the haze rather than the abrupt outline in the *Mona Lisa*. Changes in craquelure along the outlines (see photo 17) may indicate that a restorer enhanced the outlines deliberately. Thus, faint distant mountains could have been erased.

Finally, there is the problem of the overhang at the left side of the gap. The great distance to the mountains suggests a structurally impossible massive overhang. If faint mountains do belong in the gap, the structural problem vanishes, and the painting better matches the geometry of some early copies (see reference 9).

The Future for Image Processing in Conservation

Only a small fraction of the conservation laboratories worldwide have substantial budgets for research. Consequently, only a few have been able to avail themselves of large image processing facilities. Some exceptions are the National Gallery of Art's efforts with the University of Michigan, and the digital recording of one of Leonardo's codices at NASA/JPL by the Armand Hammer Foundation.

However, most researchers' computerized conservation efforts will depend on the diffusion of image processing technology into the microcomputer realm. Hardware is now available for IBM PC AT-compatible computers for handling 1024 by 1024 images. Examples of appropriate software include PCIPS by IBM, IMIGIT by Chorus, and Image-Pro by Media Cybernetics.

Museums are beginning to introduce PC-based systems. The National Gallery in London has developed an approach to the monitoring of deterioration of paintings. The National Gallery of New Zealand is upgrading its AT data retrieval system for image processing. Our UCSD program is also attempting to widen the

continued

THE POWER OF POSITIVE SYNCING.

THE ONE COLOR MONITOR WITH COMPATIBILITY ACROSS THE BOARD.

The NEC MultiSync™ is the most popular color monitor in its class today. In fact, it's in a class by itself. It's the first color monitor compatible with all three PC graphics boards made by IBM®—PGA, EGA and CGA.

Dollar for dollar, it delivers the best color resolution as well. With clarity and detail limited only by the board in your machine.

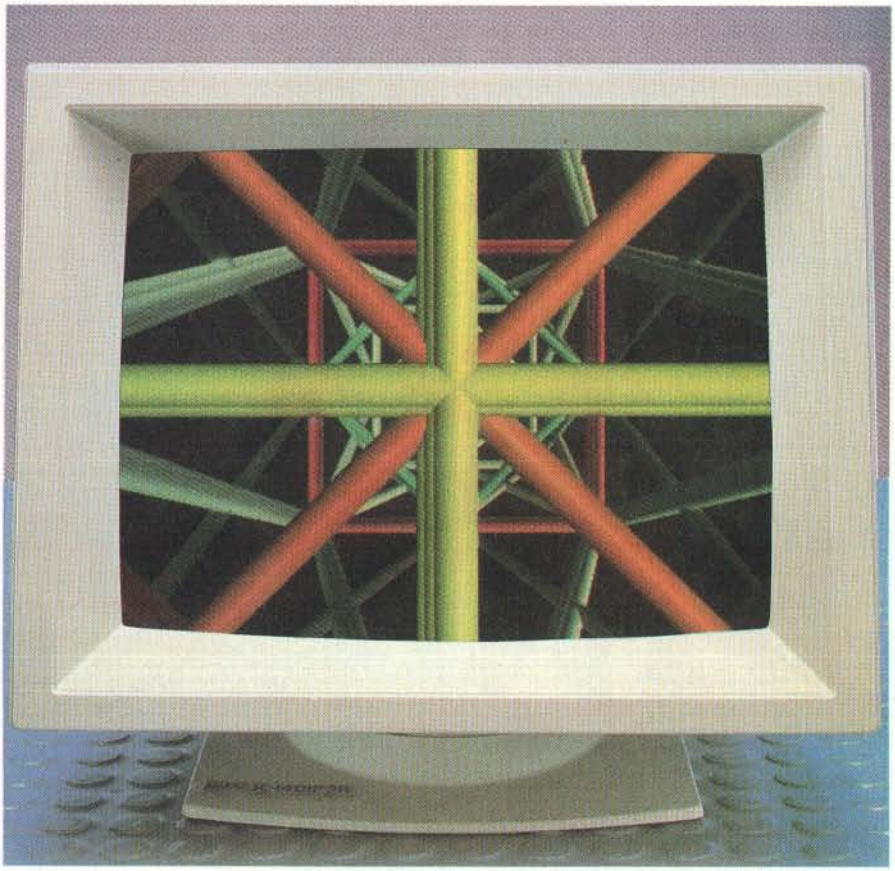


THE INTELLIGENT MONITOR.

NEC technology gives MultiSync circuitry that automatically scans incoming frequencies, then adjusts to anything from 15.75 KHz to 35 KHz. No switches to switch, no instructions from the keyboard. The monitor does it. Automatically.

MultiSync functions in TTL and analog modes. Delivers 7 switchable colors. And its resolution climbs as high as 800 horizontal dots and 560 vertical lines on a 14 inch screen.

C&C Computers and Communications



MULTISYNC™

THE INTELLIGENT CHOICE.

MultiSync is the first monitor you should consider, because it's good enough to be the last monitor you'll ever need.

So whether you're buying your first system, upgrading to color, or moving into professional business graphics, desktop publishing or CAD/CAM, visit your nearest dealer.

See a demonstration of the power of positive syncing. It will give you something great to think about.

For product information and sales assistance, call 1-800-447-4700.

For technical assistance and information, call 1-800-NEC-SOFT.

NEC Home Electronics (U.S.A.) Inc.
Computer Products Division
1255 Michael Drive
Wood Dale, Illinois 60191.

NEC

MultiSync is a registered trademark of NEC Home Electronics (U.S.A.) Inc. IBM is a registered trademark of International Business Machines.









A Film of a Different Color

Ken Sheldon

Vincent Canby, film critic for the *New York Times* calls it a "ghastly process," like "watching a movie through a large, not awfully clean fish tank." The late Cary Grant tactfully called it "a curious experience" and "extremely interesting." Woody Allen thinks it's "an ugly practice, totally venal." Nancy Reagan called it "a clever idea."

These folks, and many others, are talking about a controversial process known as "colorization," in which classic black-and-white films are being colored via computer and rereleased for the home video market.

Although some have their doubts about the desirability of coloring old movie classics such as *The Maltese Falcon, It's a Wonderful Life,* and *Miracle on 34th Street,* the two companies currently involved with the technology—Colorization Inc. of Toronto and Color Systems Technology of Hollywood—do not. The companies cite research indicating that home video watchers, especially those under age 20, just won't watch black-and-white films but will snatch up color versions of the same movies. "Today's viewing public seems to have a psychological resistance to watching black and white on television," says Wilson Markle, president of Colorization Inc.

Making video images palatable for home audiences is nothing new to Wilson Markle. In 1971, he was contracted by NASA's Jet Propulsion Laboratory to "clean up" the televised images of the moon being sent back from the Apollo missions. NASA knew that good clear pictures from space would be invaluable in selling the space program to the American public and ensuring its continued funding.

In 1983, Markle founded Colorization Inc., now owned in part by Hal Roach Studios of Los Angeles, which owns a library of over 2000 old black-and-white films. Among these are such classics as the Oscar-winning Laurel and Hardy film, *The Music Box,* which was recently colorized. In addition to privately owned films, thousands of films now in the public domain are available for coloring and rerelease. The technology has also been used to convert historic newsreel footage for docudramas on individuals such as Dwight D. Eisenhower, Martin Luther King, and Benito Mussolini.

Computer Paint-by-Numbers

The colorization process begins with the transfer of the original 35mm movie film to a 1-inch videotape, where it is cleaned up using analog and digital image processing techniques. A film technician (or "art director") then freezes the first frame of every new scene in the movie—every time the camera angle changes, a new character enters the scene, and so on.

The art director assigns colors to each object in the frame, using a graphics tablet and knowledge about the movie's script, the sets, the hair color of the stars, and the like. The two components of a color television signal are luminance (the black-and-white values) and chrominance (the color information), which consists of hue (the actual color) and saturation (the amount of color). In the colorization process, the original film provides the luminance values, while a Dubner Graphics Computer provides the hues from a palette of 16,700,000 possible colors. The art director chooses 4096 colors for each film, and the system allows up to 64 colors in each scene. The limitation is based on the fact that the system operates in real time; for the illusion of motion, the human eye requires 30 frames per second. Each frame consists of two "fields," which are "interlaced" to provide a complete frame. Thus, the system is actually producing 60 images per second.

The computer also derives the saturation from the luminance. It assigns a

prospects for microcomputer image processing in art conservation. We are presently using an IBM PC XT system to merge images of the vice president's office in the Old Executive Office Building (see photo 22) with historical images of fragments of the original stencil designs from the 1880s. (The purpose is to assist in planning the actual restoration of the room.) Our other current effort on a PC is to enhance the ice-age rock-art images of the French caves in and around Lascaux (see photo 23).

In addition to the economic and technical issues already mentioned, there is the question of psychological resistance to image processing from within the conservation community and, indeed, the









saturation of 0 wherever there is black or white (since no colors are needed there) and the maximum saturation (the greatest amount of color) somewhere in between the black and white values.

After the art director has assigned colors to the first frame, the computer digitizes the frame and compares it to the next frame in the sequence. Pixels that are unchanged (the majority) have the same color assigned to them as in the previous frame. Pixels that change are compared to pixels around them and to pixels with the same luminance in the previous frame, and are assigned a new color. The wrinkles in a jacket, for example, automatically have the appropriate shade added to them as they move. The art director makes "mid-course corrections" for any unforeseen changes in the scene that the computer cannot handle.

Even with a high-powered graphics computer, the process is tedious; it takes about 4 hours to "track" a minute of film. A film like *It's a Wonderful Life*, with some 1100 first-frame scenes to be "hand-painted," can cost several hundred thousand dollars to color—but that's a pittance compared with the cost of producing a new motion picture.

Despite the controversy surrounding colorization (or perhaps because of it), the list of films being colorized grows every day. It includes such classics as *Casablanca*, *Citizen Kane*, the Alfred Hitchcock and the Abbot and Costello television series, the entire Otto Preminger film library, and many more. With the growing power of microcomputers and the availability of image processing hardware for them, you may soon be able to color your old home movies and revive some classics of your own.

Ken Sheldon is a technical editor for BYTE. He can be reached at BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

general public in some areas (see text box above). (In a private communication to me, J. Arnold, one of the pioneers of the now-ubiquitous radiocarbon dating method, recalled meeting both apathy and antagonism upon its introduction.) After the UCSD group delivered a paper on the *Mona Lisa* results at a recent conservation-related conference, a leading conservation scientist expressed strong misgivings about image processing in art. She concluded: "And, further, you'll never convince me that Leonardo painted those trees in the background blue." Of course "those trees in the background" of the painting are really mountains; the yellow-green cast of the aged varnish had misled even this prominent professional. ■

ACKNOWLEDGMENTS

Most of the work reported here was supported by generous grants from the National Science Foundation, the IBM Corporation, CBS News, the Armand Hammer Foundation, the S. H. Kress Foundation, and Mr. Charles Tyler. Many individuals contributed to the work, especially: Ralph Bernstein, Jitendra Dave, and Joseph Myers (IBM); Robert Bernstein, Ben McGlammery, and Patrick Hudson (Scripps Institution of Oceanography); Steven Pomeroy (UCSD); and John Twilley (Los Angeles County Museum of Art). James Arnold (UCSD) has been the constant "guiding light" behind the scene. J. Weller is thanked especially for proofreading the manuscript.

REFERENCES

1. Asmus, J. F., and S. Pomeroy. "Ultrasonic Mapping of Detachments in Mural Paintings by Vasari," *Bulletin of the American Group—The International Institute for Conservation of Historic and Artistic Works*, June 1978, page 12.

2. Druzik, J. R., D. L. Glackin, D. L. Lynn, and R. Quiros. "The Use of Digital Image Processing to Clarify the Radiography of Underpainting," *Journal of the American Institute for Conservation*, Vol. 22, 1982, page 49.

3. Clark, K. "Mona Lisa," *The Burlington Magazine*, CXV, No. 840, March 1973, page 144. Also, Clark, K. *Leonardo da Vinci*, University Press, Cambridge, U.K., 1952.

4. Pedretti, C. *Leonardo: A Study in Chronology and Style*, University of California Press, Berkeley, CA, 1973.

5. Asmus, J. F., R. Bernstein, J. V. Dave, and H. J. Myers. "Computer Enhancement of da Vinci's Gioconda," *Perspectives in Computing*, Vol. 7, No. 1, Spring 1987.

6. Landgrebe, D. A., and the staff of LARS. "Automatic Identification and Classification of Wheat by Remote Sensing," LARS Information Note No. 21567, Purdue Agricultural Experiment Station Research Program Report No. 279, Purdue University, West Lafayette, IN, 1967.

7. Moik, J. G. "Digital Processing of Remotely Sensed Images," NASA Publication SP-431, U.S. Government Printing Office, Washington, DC, 1980.

8. Dave, J. V., R. Bernstein, and H. G. Kolsky. "Importance of Higher-Order Components to Multispectral Classification," *IBM Journal of Research and Development*, 26, pages 715–723, 1982.

9. Salaino, "Mona Lisa," Luchner Collection, Innsbruck, Austria.

Now There's A Management Tool That Lets You Work More Efficiently... Without Changing The Way You Work. Lotus Metro.

Lotus® Metro™ is a memory-resident program that combines the powerful efficiency of 12 business management tools with the time-saving convenience of macros.

Metro gives you more ways to get your work done. Metro has the same command and menu structures as 1-2-3® or Symphony® so you already know how to use it. And since it's from Lotus, you can count on its high quality and reliability to let you start working more efficiently—and in complete confidence—right away.

In fact, when you consider everything Metro can do, you won't believe its low price—just $85.

The Most Comprehensive Product Of Its Kind.

Metro lets you handle daily tasks on your PC more quickly and easily than ever before. You'll simplify routine—and complicated—jobs. Handle workflow interruptions more effectively. Organize your day.

In short, you'll become more productive by minimizing the time you waste.

Bring All Your Work Together.

You can customize Metro to your needs by choosing any of the following management tools:

- *Clipboard* lets you easily move data and text between 1-2-3, Symphony or other software products—as well as between the Metro management tools themselves.
- *Appointment book* keeps track of your schedule.
- *Phone book* compiles names, addresses and phone numbers—and can even dial your phone.
- *Calculator* includes memory and financial functions.
- *Notepad* lets you jot down quick ideas and memory-joggers you can retrieve at the touch of a button.
- *Editor* creates business letters and spreadsheet reports, and allows you to view and edit existing files.
- *List manager* orders daily tasks, and effectively segments/tracks "to do" lists.
- *Watch* helps you keep records of time spent on as many as 100 different projects.
- *DOS file manager* executes DOS commands from within applications.
- *Kaleidoscope* specifies colors on your screen, *Configuration* lets you build the product that best fits the way you work, *Special characters* contain a full 256 character IBM extended ASCII table.
- And *Macros* let you turn even your most complicated multi-step tasks into one-step commands.

High Quality... Total Compatibility.

Metro is built to the high quality standards of 1-2-3 and Symphony—so it won't endanger your data. Metro is unprotected, so it's easy to install and easy to use. And it can be easily removed from memory whenever you need more room for your spreadsheet or other functions.

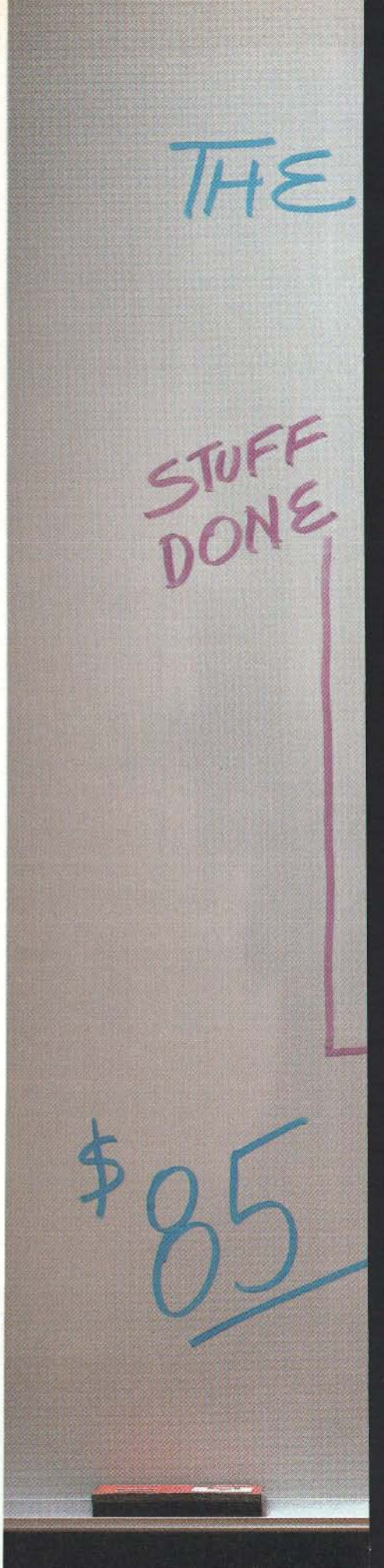
As a member of the Lotus family, Metro is the management program best suited—and designed—to work with other Lotus products. And it comes complete with Lotus' unparalleled commitment to customer service, reliability and support.

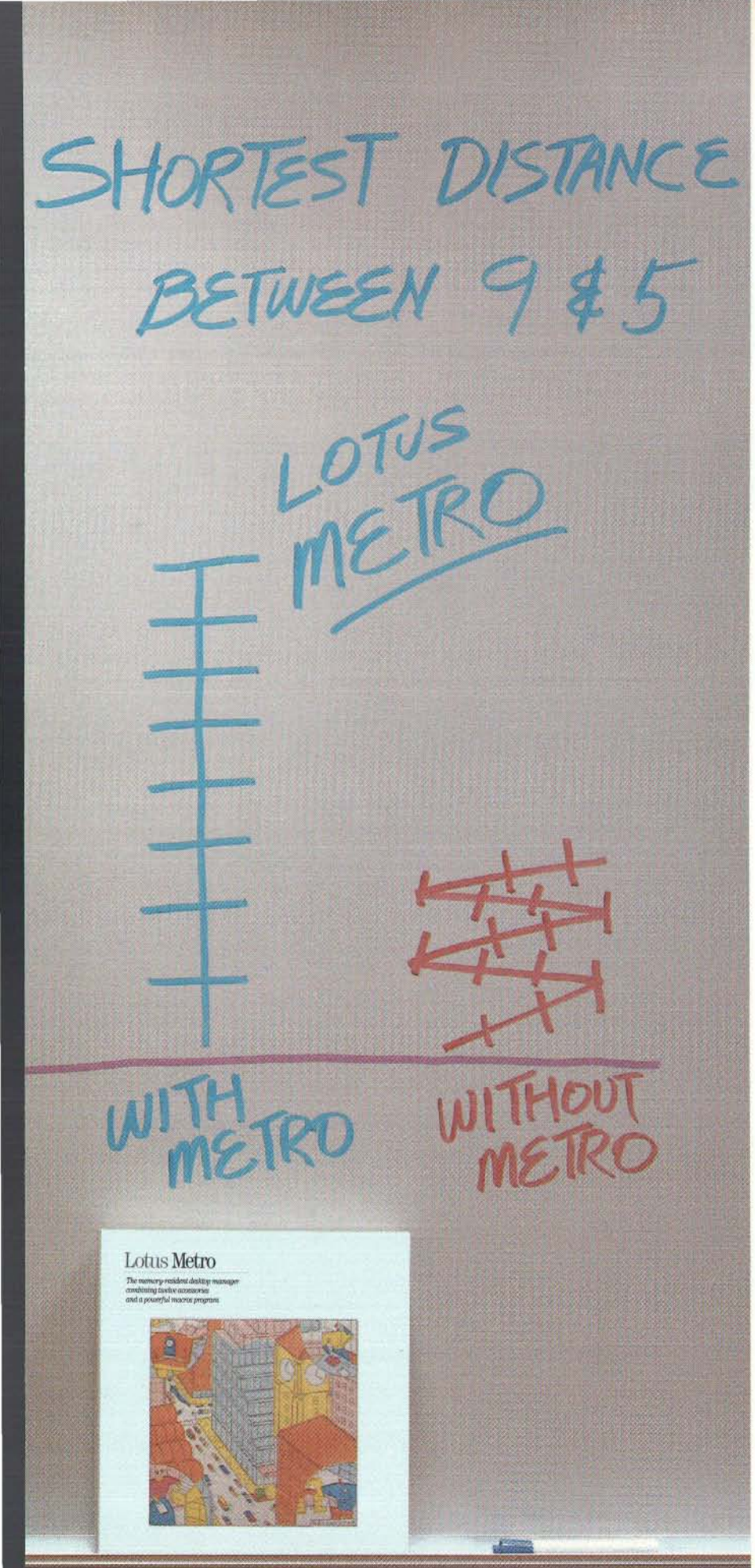
© 1987 Lotus Development Corporation. Lotus, 1-2-3 and Symphony are registered trademarks of Lotus Development Corporation. Metro is a trademark of Lotus Development Corporation.

System Requirements:

IBM® PC, XT, Portable, AT, COMPAQ® Portable, PLUS, DESKPRO. Two 5.25" double-sided disk drives (hard disk recommended for optimal performance). Minimum of 80K required for RAM-resident portion of Metro. DOS 2.0 or higher. Metro is unprotected and can be removed from memory.

Lotus Metro runs with a wide variey of software programs, including 1-2-3,® Symphony,® Symphony Spelling Checker, Symphony Text Outliner, 1-2-3 Report Writer,™ and Signal!™





Try Lotus Metro Today.

No other "desktop" product offers you the power and efficiency of Metro...

The unique combination of comprehensive management tools and macros that allows you to manage your PC... organize your workday...and increase your productivity.

And, at only $85, no other product even comes close to its value. (Especially since Metro will quickly pay for itself again and again.)

Which is why you should visit your nearest Lotus dealer to sample Metro.

Or, if you're already convinced, simply use the coupon below to order Metro directly from Lotus.

Or order Metro (Product No. YM-1690) by calling Lotus, toll free,

1-800-345-1043

Lotus Metro

The memory-resident desktop manager combining twelve accessories and a powerful macros program.

Complete and return to: Lotus Development Corporation, 90 Annex, Atlanta, Georgia, 30390-0370 or call 1-800-345-1043.

☐ Yes. I'd like to try Lotus Metro for 30 days without obligation. (YM-1690)

☐ Please send more information about Lotus Metro. (YM-2821)

Send me____unit(s) of Metro @ $85 each_____

Sales Tax** . . . . . _____

Total . . . . . _____

☐ I've enclosed my check or money order made payable to: Lotus Development Corporation.

Please charge my: ☐ VISA ☐ MasterCard

Card No. | | | | | | | | | | | | | | | | |

Expiration Date_____/_____

Signature_____

Name_____

Company_____

Address_____

City_____ State_____ Zip_____

Telephone (_____) _____

**Residents of the following states apply applicable sales tax: CA, DE, FL, GA, IL, MA, MD, MI, MN, MO, NJ, NY, OH, TX, VA, WA. Offer good in U.S.A. and Canada only. In Canada make payment by credit card or International Postal Money Order. CODs and purchase orders will not be accepted.

When you purchase Metro directly from Lotus, take your first 30 days to try it out. If, at the end of your first month, Metro does not perform as described and you've purchased it directly from Lotus, we'll gladly give you a full refund.

"A Work of Art"

Mix different sizes and styles of native and SoftCraft fonts on the same line.

Create and print your own characters and logos up to 2" high and 2 2/3" wide.

Special formatting features let you wordwrap, or position text centered, justified, flush left or right, and much more.

Automatic pagination makes formatting long documents easy! No length limits!

Kerning option kerns a document and automatically forms ligatures.

Hundreds of optional fonts from 4 to 72 points available.

Send us your logo or signature for digitization.

Create boxes shaded or patterned according to your specifications. (new!)

Standard fonts include Sans Serif, Roman, *Script*, Old English, **bold**, *italic* in sizes from 8 to 24 points.

Automatic column command. (new!)

Includes over 1500 mathematical, foreign language and special symbols that can be scaled to any size up to 1 inch.

Drop in graphic images captured from a file or from the screen display of programs such as Lotus 1-2-3. (new!)

TO: Joan Prentiss-Winston, CEO
FROM: Bertram W. Finch, CFO

PROPOSAL

After researching all our options, I can confidently recommend a software product by SoftCraft, Inc. The product is called Fancy Font and it would meet all our typesetting needs. Fancy Font is cost effective and is compatible with all our laser *and* dot matrix printers, as well as any of our installed word processors.

Fancy Font can meet the needs of the following departments:

Graphics

Our graphic artists will find Fancy Font useful for creating vu-graphs, presentation materials and advertisements. There are now commands to create and work with graphic images. SoftCraft also offers a special service to digitize logos and symbols our artists design.

Research and Development

Fancy Font provides the special symbol and mathematical fonts this department needs to produce proposals and technical reports containing scientific notation and mathematical formulae.

$$\pi(n) = \sum_{k=2}^{n} \left\lfloor \frac{\phi(k)}{k-1} \right\rfloor$$

Documentation

Fancy Font will save time and money in the production of our manuals and technical documents that require several sized chapter, title and section headings in a variety of text formats including portrait and landscape mode. The kern option creates ligatures for the most polished looking documents.

Public Relations and Marketing

Fancy Font can make all our promotional materials look more professional. It is a software package versatile enough to produce news releases, invitations, company newsletters, even last-minute sales presentations, all looking as though they had been done by a professional typesetting service.

Manufacturing

With Fancy Font, we can design our own product labels. The SoftCraft font library even has a bar code font available for inventory control purposes.

Accounting

Fancy Font can produce columns of figures in small typefaces and can be used with our Lotus spreadsheets and graphs. Perfect for doing annual financial reports.

RECOMMENDATION: Fancy Font can meet the special needs of virtually every department in the company. No special hardware or installation is required, so we can use it as soon as it arrives. Fancy Font would cut company costs by reducing printing and typesetting fees and bring in-house, several services that we now send out. **I recommend that we purchase Fancy Font immediately.**

Bertram W. Finch

Bertram W. Finch

Let Fancy Font turn your printer into a personal typesetter.

Fancy Font gives you the utmost in document versatility by allowing you to mix a variety of font styles and sizes in either portrait or landscape mode with your printer's native fonts.

If you have an inexpensive dot matrix printer, Fancy Font turns low-resolution print quality into stunning high-resolution, proportionally-spaced text rivaling laser printer output.

If you have a laser printer, Fancy Font turns it into an economical desktop publishing system. Fancy Font prints with a wide variety of typestyles and sizes normally available only from expensive typesetting services.

Fancy Font runs on all IBM PC's and compatibles and works with word processors, spreadsheet and database programs.

SoftCraft, Inc. offers a wide variety of personal typesetting software and fonts. Call our toll-free number for information on these and other products:

Fancy Font	**$180**
Fancy Word	**$140**
Laser Fonts	**$180**
SoftCraft Font Editor	**$290**
Business Font Pack	**$90**
Font disks	**$15 each**

Now with graphics!

SoftCraft, Inc.

16 N. Carroll St., Suite 500, Madison, WI 53703 (608) 257-3300 **1-800-351-0500**

The sample letter above was printed in one pass with Fancy Font on an HP LaserJet+.

Inquiry 279 for End-Users. Inquiry 280 for DEALERS ONLY.

Introduction to Image Processing Algorithms

An overview of the basics, with code to get you started

Benjamin M. Dawson

IMAGE PROCESSING is the science of modifying and analyzing pictures. Image processing algorithms are step-by-step procedures for performing image processing operations. People often implement such algorithms using computers, which are flexible and have relatively low processing and memory costs. The algorithms are expressed as, and become nearly synonymous with, programs for the computer. However, the algorithm can also specify other operations such as how to acquire the image. Special image processing hardware often supplements the computer.

To help you understand and try some of these algorithms, I will describe a generic image processing system that you could assemble from a personal computer and an image-processing or graphics board. I wrote a simple image-processing package (SIMPP) that runs on such a system and contains programs for many of the algorithms described. With this hardware and software and some ideas about which algorithms to use, you can start to do interesting image processing.

Generic Image Processing Hardware

A minimal generic image processing system consists of an image-acquisition device, an image memory, a computer (with disks, keyboard, etc.) that can access this memory, and a device that can display the contents of memory. This system acquires, processes, and displays monochrome (gray-tone) images. You can display image memory values in color by adding output lookup tables.

The image-acquisition device puts an image into the image memory. This usually involves digitizing—scanning a continuous image (such as a photograph) and breaking it into an array of digital intensity values called pixels (picture elements). Most image processing systems have, for example, an A/D converter that transforms the signal from a video camera into a pixel array in the image memory. If the image is already represented as pixels, as in a computer graphics image, image acquisition consists of simply moving the image from disk to the image memory.

The acquisition device can write to the image memory, which can be read and written to by the computer's CPU, and read by the display device. If the image memory stores an entire video image, it is often called a frame buffer or frame store. For acceptable intensity and detail resolution, an average monochrome image must be represented by an array of at least 256 by 256 pixels, and each pixel must have at least 6 bits of value. In the examples to follow, assume that a pixel has an 8-bit byte, which means that it can have 2^8 (256) different gray-level intensities.

The computer processes the pixels in the image memory. The display device converts the processed pixels back into spatially organized image intensities. The display device is usually a D/A converter that drives a monochrome or color TV monitor, although people have used line printers or other devices.

A lookup table (LUT) changes a pixel's value based on the values in a table. This hardware consists of a memory that has a storage location for each possible pixel value. An input pixel value is used as an address into this memory, and the output is the value at that address. The input value "looks up" the output value. An LUT computes an arbitrary function of one or more variables, with a domain and range limited to the possible pixel values. For example, an input value of 32 to the function $4x-13$ gives a result of 115; rather than redoing the calculation each time, the system can "look up" the correct result in the LUT.

An image processing system can have three LUTs that map the image memory to the display device. These LUTs output values to the red, green, and blue channels of a color monitor, based on some input pixel value. This lets you display different gray levels from the monochrome image in various arbitrary colors, a technique often called pseudocolor.

Several manufacturers provide the acquisition device, image memory, output LUTs, and display device on one computer board. You can make an image processing system by combining one of these boards (or a graphics board if you don't need "live" video input) and a standard personal computer. As an example, I used an IBM PC AT computer and an Imaging Technology Series 100 image processing board. You could even start with an EGA (Enhanced Graphics Adapter) board as

continued

Benjamin M. Dawson, Ph.D. (Department of Brain and Cognitive Sciences, E10-120, Massachusetts Institute of Technology, 79 Amherst St., Cambridge, MA 02139), is a research scientist in the area of computer vision and image processing.

Table 1: *The Simple Image Processing Package (SIMPP) routines. Note that the arguments x,y specify the start of an area to process and dx,dy specify its size.*

Interface Routines

sim_open( ) = Opens and initializes image processing hardware.

sim_close( ) = Closes image processing hardware.

acquire( ) = Puts an image into the image memory.

write_LUT(color,loc,val) = Sets the location, loc, in the LUT specified by color, to the value val. This routine is optional.

read_pixel(x,y) = Returns the value of a pixel in frame memory located at coordinates *x,y*.

write_pixel(x,y,v) = Writes a pixel of value v into the frame memory at location *x,y*.

Primitive Operations

read_hline(x,y,n,b) = Reads a horizontal line of pixels starting at location *x,y* and of length *n*. Places values in buffer *b*.

write_hline(x,y,n,b) = Writes the values in buffer *b* to a horizontal line of image memory starting at location *x,y* and of length *n*.

read_vline(x,y,n,b) = Reads a vertical line of pixels starting at location *x,y* and of length *n*. Places values in buffer *b*.

write_vline(x,y,n,b) = Write the values in buffer *b* to a vertical line of image memory starting at location *x,y* and of length *n*.

read_area(x,y,dx,dy,b) = Reads an area into buffer *b*.

write_area(x,y,dx,dy,b) = Writes an area from buffer *b*.

copy_area(x,y,dx,dy,xd,yd,dxd,dyd) = Copies the image area into the destination area starting at *xd,yd* and of size *dxd,dyd*.

Point Processing

ptransform(x,y,dx,dy,t) = Transforms the area using transformation table *t*.

histogram(x,y,dx,dy,h) = Computes the histogram *h* of area.

plot_histo(x,y,dx,dy,h,v) = Plots the histogram *h* in specified area and using pixel value *v*.

clip_histo(h,t,low,high) = Scans the histogram *h* from first to last and last to first index and finds the first bin counts greater than *t*. Returns these bin numbers in low and high.

Area Processes

convolve(x,y,dx,dy,m,n,kernel,output) = Convolves the image area with a kernel of size *m,n* and specified by array kernel. The output routine controls the treatment of negative convolution values.

label(x,y,dx,dy,bin0,bin1,minpix,blabel,elabel) = Labels the binary image in the specified area. The binary image values are bin0 and bin1. The area must have more than minpix pixels. Labels are assigned values starting with blabel and ending with elabel.

Geometric

rotate(x,y,dx,dy) = Rotates the image area clockwise by 90 degrees.

stretch(x,y,dx,dy,xs,ys) = Stretches (enlarges) the image area by *xs* and *ys*. The image is stretched into the same areas starting from the upper left corner.

continued

image store and display device, although the number of bits per pixel and the display's resolution and color capabilities limit what you can do.

Software Interface to the System

Six software routines interface the image processing hardware to SIMPP and your programs (see table 1). The sim_open( ) routine opens the hardware and could initialize the hardware, clear the image memory, or whatever you want. The sim_close( ) routine closes hardware.

You use acquire( ) to read an image into the image memory. You assume that the entire image memory is filled by this operation. The write_LUT(color,loc,val) routine writes the value val into location loc in the output LUT specified by color (e.g., red, green, or blue). This routine is optional.

The read_pixel(x,y) routine returns the pixel value at horizontal location *x* (column) and vertical location *y* (row) in the image memory. And write_pixel (x,y,v) writes the value v into location *x,y*. Note that these routines assume that *x* starts at 0 at the left of the image and increases to the right, while *y* starts at 0 at the *top* of the image and increases downward. This odd coordinate system is called "video coordinates" because it is based on the way a television image is scanned. Pixel values start at 0 (black) and go through grays to the maximum pixel value (white).

You will need to write versions of these six routines—which will vary depending on your CPU, image processing board, and so on—if you want to use the SIMPP programs. If you don't have output LUTs, you can compile SIMPP not to use the write_LUT function.

Classifying Algorithms

You can classify image processing algorithms in many ways. If an algorithm changes a pixel's value based only on that pixel's value, it is called a *point process*. If the algorithm changes a pixel's value based on the value of that pixel and the values of neighboring pixels, it is called an *area process*. If the algorithm changes the position or arrangement of the pixels, it is called a *geometric process*. Algorithms that change pixel values based on comparing two or more images are called *frame processes* because video images are called frames.

The goals of image processing include enhancement or modification of the image to improve its appearance or highlight information, measurement of image elements, classification or matching of image elements, and recognition of items in the image. Image measurement makes few

continued

VRROOOM.



INTRODUCING FAST FORWARD.™
NOW ANY SOFTWARE CAN RUN UP TO 10 TIMES FASTER.

No more doodling while your database goes digging. Or lollygagging while your spreadsheet loads. Or taking five while your word processing program takes forever.

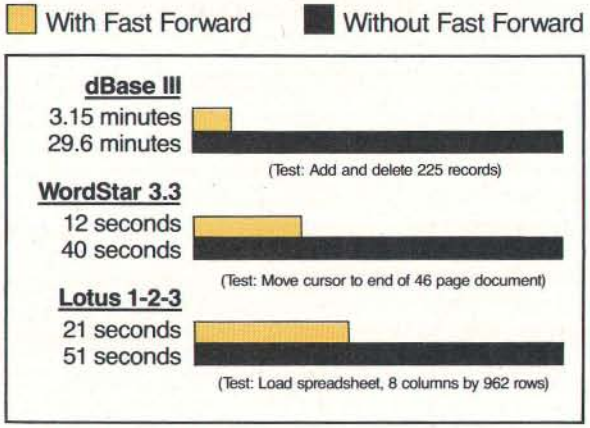
With Fast Forward, any software runs 2 to 10 times faster.

CAN SOFTWARE REALLY DO THAT TO SOFTWARE?

Fast Forward can. Normally, your computer is constantly going to your disk and wading through massive amounts of data.

But with Fast Forward, data is retained in your computer's internal memory. Which is incredibly fast. Much faster than hard disks. Hundreds of times faster than floppies.

FAST FORWARD PERFORMANCE



All tests done on 640K IBM PC, 20 megabyte hard disk and floppy drive. 320K RAM allocated to Fast Forward.

THE MORE YOU USE IT, THE FASTER YOU GO.

Once installed, Fast Forward works invisibly. As you use data, it's automatically stored in your computer's memory–and instantly available the next time you need it. Programs requiring frequent disk access (like dBase III) will show amazing improvements. And adding extended memory gives Fast Forward more room to work. So software runs even faster.

PERFORMANCE HAS A NEW PRICE: $69.95.

You can buy a faster computer. Or an expensive accelerator board. But if you're ready to turn on the speed without turning over a bundle of money, ask for Fast Forward. It's from the Mark Williams Company, makers of quality software tools since 1976. And it's available at your software dealer. In the software department of your favorite bookstore. Or by calling 1-800-MWC-1700.* And hurry. Because it'll be going fast.

*In Illinois: (312) 472-6659



60-DAY MONEY-BACK GUARANTEE

Mark Williams Company
1430 West Wrightwood
Chicago, Illinois 60614

Fast Forward runs on IBM-PCs and 100% compatibles. Not copy protected.
© 1987, Mark Williams Company

Utility

clear_area(x,y,dx,dy,v) = Clears the area to pixel value *v*.

save_image(x,y,dx,dy,fname) = Saves the image area in disk file fname.

read_image(x,y,dx,dy,fname) = Reads the disk file fname and displays it in the specified area.

Listing 1: *A C code fragment for a simple point-process algorithm.*

```
/*  Point process area starting at x,y = 0,0 and of size *
 *  XSIZE,YSIZE.                                          */
  for (y = 0 ; y < YSIZE ; y++) {
        for (x = 0 ; x < XSIZE ; x++) {
              write_pixel(x,y,  pfun(read_pixel(x,y),x,y) );
        }
  }
```

assumptions about what things are in the picture, while classification and recognition require successively more knowledge about what can appear in an image. For example, you can measure how many pixels in a remote sensing (satellite) image of the earth have a certain range of values. If you know that wheat corresponds to these values, you can classify the image into wheat and nonwheat areas. If you provide the machine with knowledge about the structure of wheat fields, it might be able to recognize these fields in the image. You could also use pseudocolor to highlight the recognized areas.

Additional ways of classifying image processing algorithms include image-based versus symbolic methods, linear versus nonlinear, and the knowledge level used. Image-based algorithms transform pixel values into other pixel values or locations using numerical or logical operations, while symbolic algorithms symbolically manipulate knowledge about pixel structures.

The knowledge level used in an algorithm can range from simple assumptions about the physics of image formation to specific world knowledge about possible items in a scene. The above example of the wheat-field measurement, classification, and recognition illustrates the knowledge-level dimension. I will discuss only algorithms that are image-based, require minimal knowledge about the image contents, and are therefore not recognition algorithms.

You can now "hang" some example algorithms on this classification framework and your conceptual or real hardware. Since the goal is understanding, I make no claims that the examples are complete or efficient. In particular, if you are using SIMPP and a personal computer to try the examples, you will find the area processes to be rather slow. If this bothers you, plenty of expensive hardware is available to speed the processes up—or you can go to lunch while the computer works and dream about such hardware.

Point Processes

A point-process algorithm scans through the image area and uses the pixel value at each point (and perhaps the point's address) to compute a new value for the point. The algorithm is expressed as a C code fragment in listing 1. [Editor's note: *The listings from this article, IPLISTS.C, and the complete SIMPP programs, written in C, are available on disk, in print, and on BIX. See the insert card following page 352 for details. Listings are also available on BYTEnet. See page 4.*]

If the transformation pfun( ) is only a function of the pixel value, then the function can be implemented by a lookup table to save computation. The SIMPP routine ptransform implements the software equivalent of the LUT hardware.

You can use point processes to enhance or modify pixel values. For example, adding 40 to each pixel brightens the image (photo 1) and could improve the display's appearance. The transformation function is simply pfun(v) = v+40.

If the pixel value and its location are used, then you can use the point process to correct shading or smoothly change pixel values in an image area. Shading is an image artifact caused by slow spatial shifts in scene lighting or camera bias and sensitivity. A point process that computes the inverse of the shading functions can eliminate (correct) much of this shading.

continued

All this—and only 15 pounds!

Power for performance:
- IBM PC AT compatible
- 80286 processor, running at 8MHz
- MS-DOS™ 2.11* operating system, BASIC

More storage for more applications:
- 640KB RAM, extendable to 2.6MB
- Built-in 10MB hard disk
- Built-in 720KB 3½" diskette drive

The display with clear advantages:
- High-resolution gas plasma display
- IBM Color Graphics Adapter (CGA) compatible
- 80 x 25 character display
- 640 x 400 bit-mapped graphics display

Interfaces to make connections a snap:
- RGB color monitor port
- Parallel printer port
- RS-232C serial port

Built-in convenience:
- Full-sized 81-key keyboard
- 110/220 VAC switch-selectable power supply
- Only 12.2" W x 3.1" H x 14.2" D

Important extras *included*:
- SideKick® and SuperKey® software
- Attractive carrying case

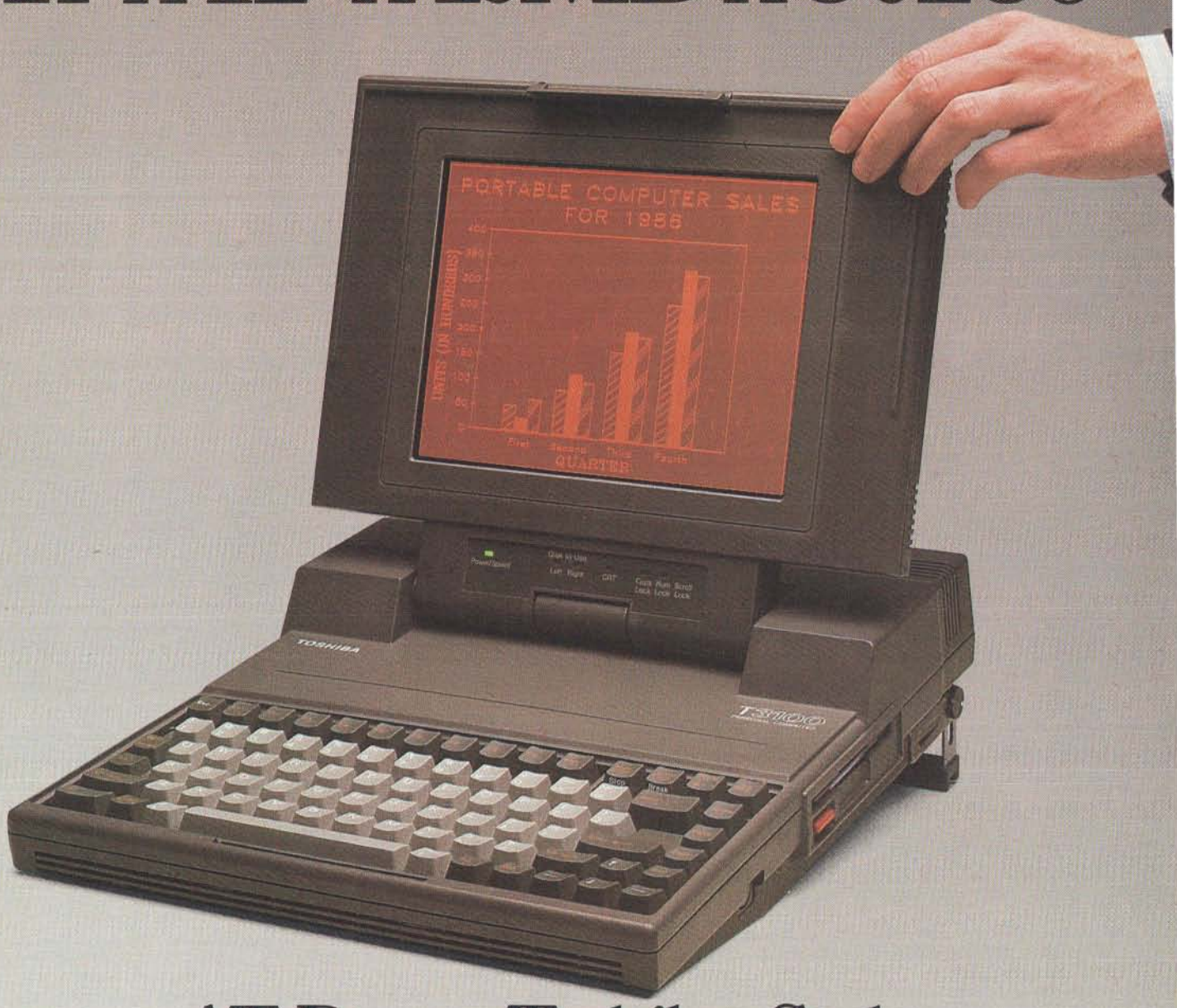
"Big" system expansion options:
- Internal 300/1200 bps Hayes®-compatible modem
- Internal 2MB extended memory card
- 15-key numeric keypad
- External 5¼" 360KB diskette drive
- Floppy Link to desktop 5¼" diskette drive
- Expansion chassis with five IBM-compatible slots

The T3100. So powerful—and so portable— it's like being able to take your whole office wherever you work.

*MS-DOS 3.2 operating system available soon.

TOSHIBA

14"x12"x10MB x80286*



AT Power, Toshiba-Style.

Until now, working away from your office meant having to settle for lesser computers—or no computer at all.

Toshiba ends that compromise. The T3100 delivers the power of an IBM® PC AT™ in a lean, 15-pound computer that you can take with you. With a full-sized keyboard and advanced gas plasma display that give you equal comfort and clarity on your desk—or on the road.

Don't let its size fool you.

Though the T3100 is no bigger than many laptop computers, it offers the power of a full-function IBM compatible desktop AT system. You get the speed and ease of a built-in hard disk, communications and expansion options, and more—including dual-voltage power that lets you plug in and go to work just about anywhere in the world.

*Okay, we exaggerated. It's actually 14.2" x 12.2". But you really get a *10.6MB* built-in hard disk.

See the system that has all of the industry experts so excited. Call:

1-800-457-7777 for your nearest Toshiba computer and printer dealer.

In Touch with Tomorrow

TOSHIBA

TOSHIBA AMERICA, INC., Information Systems Division



Trademarks: PC AT–International Business Machines Corporation; MS-DOS–Microsoft Corporation. Registered Trademarks: IBM–International Business Machines Corporation; Hayes–Hayes Microcomputer Products, Inc.; SideKick, SuperKey–Borland International, Inc.



Photo 1: *The right half of this image has been brightened by adding 40 to each pixel value.*



Photo 2: *An image of a bride, before image processing.*



Photo 3: *The result of modulating the contrast of photo 2 by a Gaussian curve, which provides an "aura" effect in the center.*

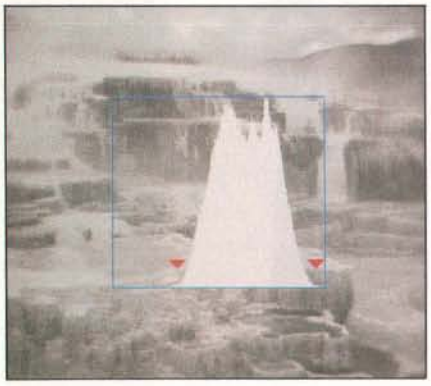


Photo 4: *An image of Athena's terrace in Yellowstone National Park, overlaid with its histogram. Red arrows indicate the lowest and highest "bins," as found by SIMPP's* clip_histo *routine.*



Photo 5: *Improved contrast of photo 4 results from histogram-based contrast stretching.*

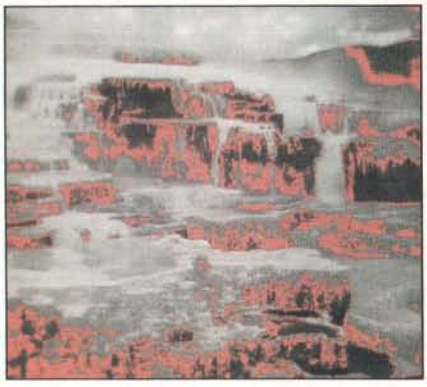


Photo 6: *Using the output LUTs, pixel values between 75 and 95 have been highlighted in red. This tends to outline dark areas of the image.*

Of course, this requires that you estimate the shading functions.

By smoothly changing the pixel values in an area, you can highlight or adjust the contrast of areas. This can produce results similar to the photographic darkroom techniques of burning and dodging (methods of adjusting the contrast locally). Photo 3 shows the result of applying the following point transformation to the image shown in photo 2:

```
output_value = input_value*k*
  exp(-(x*x/l + y*y/l))-m
```

where k, l, and m are constants that adjust the extent and amount of change, x ranges from -XSIZE/2 to XSIZE/2, and y ranges from -YSIZE/2 to YSIZE/2. This increases the contrast at the center of the image and fades the edges.

To generate an *intensity histogram* you count the number of times a pixel intensity occurs in an image area. If you are using 8-bit pixels, 256 pixel values are possible. You scan the image area and increment the values in a 256-word array h[ ] based on the pixel value. Listing 2 gives a code fragment for this algorithm.

The histogram is an example of image measurement. Since it examines a single pixel at a time, you can also classify it as a point process—one that doesn't change the pixel's values, however.

The information provided by the histogram is useful for image enhancement and classification. Photo 4 shows the histogram of an image over the image (created using the SIMPP plot_histo routine). The array values (called the histogram "bins") go from an intensity of 0 on the left to 255 on the right of the plot, and the height of the lines represents the number of pixels of each intensity. As you can see, this image has few high or low pixel values.

You can use this information to improve the image contrast. Starting at intensity 0, search the histogram for the first bin with more than a specified number of pixel counts, say 30. You do a similar search starting at the highest index. The histogram bins between these two values represent most of the pixels in the image. You set up a point process that sets pixel values below the low bin (left arrow in photo 4) to 0, and above the high bin (right arrow) to 255. The pixels with values in between are multiplied to increase their value so that they span the range of 0 to 255. Listing 3 shows a code fragment that performs this operation.

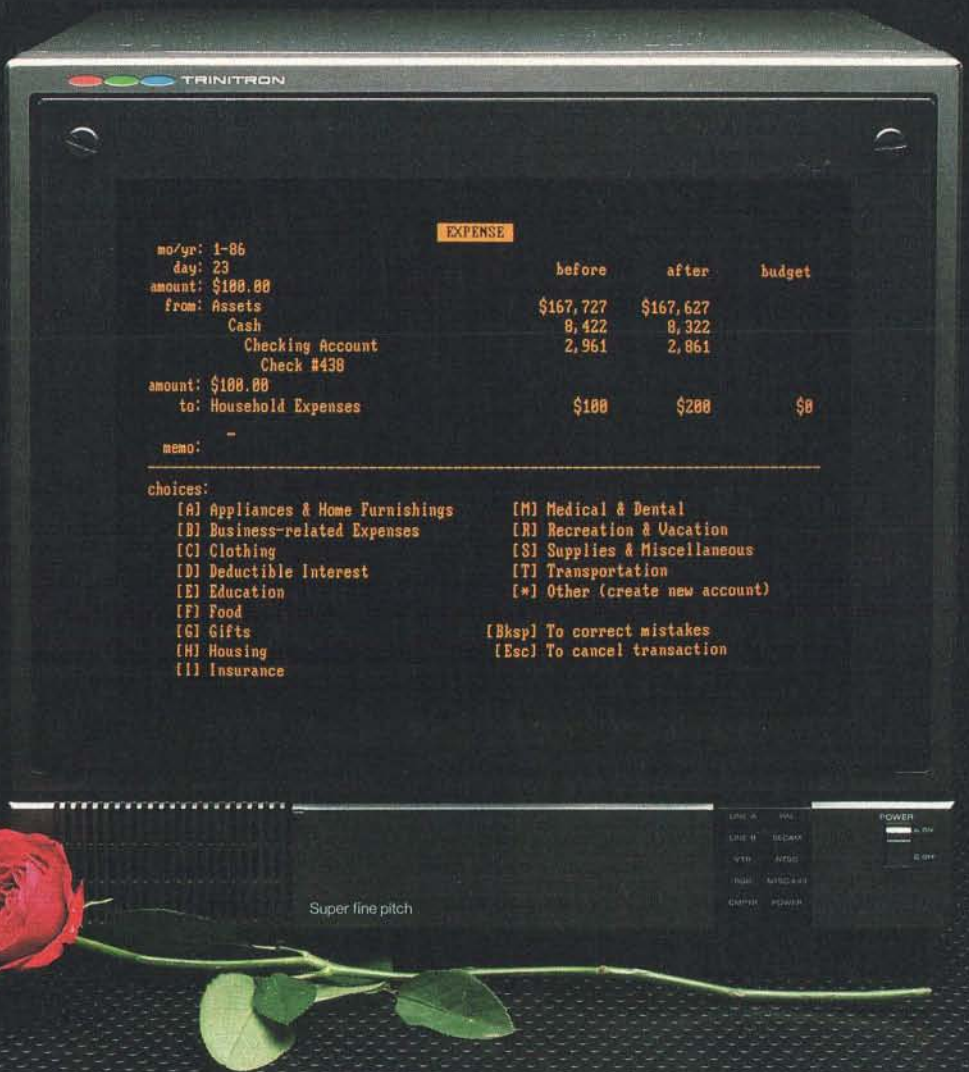
The image with improved contrast is shown in photo 5. This is a simple form of contrast enhancement. Note that you have lost some information—the pixel values below low_bin and above high_bin have been set to constants. In general, image processing operations lose information in return for selecting or accentuating other information.

This algorithm used three simpler algorithms: a histogram, a histogram clip, and a point process. Most algorithms are com-

continued

Inquiry 293 ⟶

OUTSTANDING



If slow and cumbersome program operation has kept you laughing (and frustrated) about using a personal computer for home accounting ... Finally, an Outstanding Home-Accounting System! CashTrack™ CashTrack redefines home accounting with an easy-flowing yet versatile accounting structure, a beautiful concept for presenting unaccounted-for-outflow, and an execution speed that makes other "home-accounting" packages obsolete.

Take CashTrack for a Test Drive at your dealer. You will be convinced; CashTrack has no competition.

Now Hard Disk Compatible!

See Your Dealer. Most dealers have been set up with special hands-on instructions to guide you through all aspects of program use in thirty minutes or less. If your dealer doesn't have these instructions, write or call SubLOGIC for more information. For direct orders, please enclose $149.00 plus $4.50 for shipping and specify whether you want UPS or first class mail delivery. Visa, MasterCard, American Express, and Diners Club accepted.

CashTrack™

subLOGIC Corporation
713 Edgebrook Drive
Champaign IL 61820
(217) 359-8482 Telex: 206995
ORDER LINE: (800) 637-4983
(except in Illinois, Alaska and Hawaii)
Open 7 AM to 9 PM Central Time

pounds of other algorithms. Therefore, you must know which algorithms to apply and in what order to apply them in order to reach a processing goal.

Pseudocoloring of a monochrome image is another example of a point process. In this case, the pixel value is the argument (input) for three different functions, and the output of these functions drives the red, green, and blue guns of a color monitor. This lets you color a monochrome image in any way you want. Of course, if you have 8-bit pixels, you can display only 256 colors at a time.

In photo 6, I used pseudocoloring to highlight a range of pixel values by displaying them in color, while the rest of the pixel values are displayed as gray tones. The code for doing this (see listing 4) first sets all three output LUTs to "linear" values (input = output) and then selectively changes a specified band of pixel values to be displayed in red.

Note that changing the output LUTs will change the appearance of the entire image, but not the pixel values in the image memory. The output LUT transformation may be easily changed, but you cannot apply it to only a portion of the image.

Area Processes

An area process uses neighborhood information to modify pixel values or assert the existence of some property at the image points. Area processes are typically used for spatial filtering (such as filtering out repeated elements) and changing an image's structure. They can "sharpen" the image's appearance by accentuating intensity changes and can also provide many other useful enhancements. Some of these include finding objects by matching images, measuring image properties, making assertions about object edges in the image, removing noise, and blurring or smoothing the image.

Convolution is a classic image processing algorithm commonly used for spatial filtering and finding image features. Despite its name, convolution is not difficult to understand. But it is computationally expensive. Consequently, some implementation issues must be considered.

The convolution operation replaces a pixel's value with the sum of that pixel's value and its neighbors, each weighted (multiplied) by a factor. The weighting factors are called the convolution kernel. Suppose that you use a 3- by 3-pixel neighborhood and kernel. You label the image points $p(x,y)$ and the kernel points $k(x,y)$ where $x = 0$, 1, or 2. Then the center pixel, $p(1,1)$, is replaced by the linear sum of the points times the kernel values

$$\begin{aligned} p(1,1) = {} & p(0,0)*k(0,0) + p(1,0)*k(1,0) \\ & + p(2,0)*k(2,0) + p(0,1)*k(0,1) \\ & + p(1,1)*k(1,1) + p(2,1)*k(2,1) \\ & + p(0,2)*k(0,2) + p(1,2)*k(1,2) \\ & + p(2,2)*k(2,2) \end{aligned}$$

or

$$p(1,1) = \sum_{m,n=0}^{2} k(m,n)*p(m,n)$$

(This is actually a correlation operation—for convolution you would reverse the order of the kernel values. Correlation is slightly easier to understand and many image processing convolution kernels are symmetric and, therefore, equivalent to correlation. Further discussion of this is outside the scope of this article—see the bibliography for more information.)

To convolve an image area, you repeat this operation at every pixel position in the image. You can think of this as sliding a kernel matrix over each row of pixels in the image matrix. At each point, you multiply the kernel values with the image values "under" it, sum the result, and replace the pixel at the center of the kernel with that value. The equation then becomes

$$p(x,y) = \sum_{m,n=0}^{2} k(m,n)*p(x+m,y+n)$$

Convolving an area of size X by Y with a kernel of size n by m requires $X*Y*n*m$ multiplies and adds. Thus, a 256 by 256 image with a 3 by 3 kernel requires 589,824 multiply/add operations; this can take a long time on a computer without fast multiplication hardware. (See figure 4 of "Finding the Titanic," on page 108

continued

Listing 2: *A C code fragment for the histogram algorithm.*

```
/* Use long values as sum could be over 16 bits */
  long h[256];
/* zero histogram array */
  for (i = 0 ; i < 256 ; i++) h[i] = 0L;
/* Scan area and count pixel values */
  for (y = 0 ; y < YSIZE ; y++) {
        for (x = 0 ; x < XSIZE ; x++) {
              h[read_pixel(x,y)] = h[read_pixel(x,y)] + 1L;
        }
  }
```

Listing 3: *A C code fragment that uses the histogram algorithm to perform contrast stretching.*

```
  long h[256];

/* Histogram area, result into array h */
  histogram(x,y,dx,dy,h);                  /* SIMPP routine */
/* Find the low and high bins based on minimum count of 30 */
  clip_histo(h,30,&low_bin,&high_bin);     /* SIMPP routine */
/* Compute the factor for stretching the in between values */
  step = 256.0/(double)(high_bin-low_bin+1);  /* step delta */
  step_value = 0.0;                        /* Step value */
/* Form a translation table (LUT), tran[] for enhancing
   contrast */
/* Values below low_bin are set to minimum pixel value */
  for (i = 0 ; i < low_bin ; i++) tran[i] = 0;
/* Values between low_bin and high_bin are stretched to range
   from 0 to 255 */
  for (i = low_bin ; i <= high_bin ; i++) {
      tran[i] = step_value;
      step_value += step;
  }
/* Values above high_bin are set to maximum pixel value */
  for (i = high_bin+1 ; i < 256 ; i++) tran[i] = 255;
/* Now point process area using the translation table,
   tran[] */
  while (dy--) {
      for (i = x; i < x + dx; i++) {
            write_pixel(i,y,  tran[read_pixel(i,y)] );
      }
  }
```

OMNI-READER™

NOW YOUR COMPUTER CAN READ. A REVOLUTION IN TAKING WORDS FROM PAGE TO COMPUTER.

WAS ~~$799~~
NOW $199*

* LIMITED TIME ONLY
FREIGHT PREPAID ANYWHERE
IN THE CONTINENTAL U.S.A.

PC MAGAZINE PRODUCT OF '85

WORD PROCESSOR AND COMPUTER COMPATIBILITY.
The OMNI-READER can read text into most word processors, micro and personal computers. It attaches through a Serial RS232C interface as easily as a modem.

TYPEFACE QUALITY.
OMNI-READER has the ability to read letter quality text that has been printed on a letter quality printer or type writer in one of the four following typefaces.

TYPEFACE RECOGNITION.
The OMNI-READER can read four of the most commonly used typefaces: Courier 10, Courier 12, Letter Gothic and Prestige Elite.

MANUAL OPERATION.
Alpha or numeric print is scanned line by line by moving the reading head along the text. Capable of scanning both forwards and backwards, the reading head can be used to input all or selected portions of text.

GUIDE RULE. (pat. applied for)
A specially engineered guide rule makes it easy to align text. Because of the unique clock track, the reading head can be moved at variable speed and still read text. Scan time 2-3 seconds a line.

Each OMNI-READER comes with I.B.M. PC/Compatible or Apple MacIntosh software - at no extra charge. Interface Cable available for $16.00 extra. Specify I.B.M. or MacIntosh.



30 Day UNCONDITIONAL Replacement Warranty.

TO ORDER PLEASE CALL
TOLL FREE 1-800-523-4898
IN TEXAS 1-800-722-6013
TECH. ASST. 817-589-0313

Accepting major credit cards - C.O.D.: Visa, Master Card, and American Express or send money order or check to:

G.A.S. INTERNATIONAL, INC.

P.O. BOX 1282, EULESS, TEXAS 76040

Inquiry 115

of the March 1986 BYTE, for an example of such a 3 by 3 convolution.)

When you implement the algorithm, consider the following issues. First, you can't just put the result of the convolution back in the frame memory. If you did, then the next convolution, say one position to the right of the first, would use results from the previous convolutions for part of its input values. In effect, this produces a recursive or infinite impulse response filter. While this might be useful, it is difficult to understand and predict the filter response. To avoid this, you can either buffer the output pixel values in a temporary array and write them to the image memory when you have finished using an area, or you can write them out to a nonoverlapping part of the image memory.

You might have noticed another problem: If the kernel is scanned over the image and you replace only the value under the center of the kernel, what do you do when you get to the edges of the image? For example, if you use a 3 by 3 kernel, a 1-pixel border (box) will be around the image where you cannot perform the convolution. The result of the convolution will always be a border of "garbage" equal to half the kernel size around the outside. You can just ignore this border of garbage, set it to 0, or copy the nearest meaningful value into it. The kernel size is usually odd. If not, the borders are asymmetric, because in a digital image you can't put a pixel back in the middle of an even set of pixels.

A third issue is that the result of the convolution on any pixel could exceed the number of bits allotted to that pixel—as large as the number of kernel elements times the number of bits in a pixel. In your generic system, for example, that would be 3 by 3 by 256, or 2304, for which you would need 12 bits per pixel—but you have only 8 bits per pixel. You must keep enough accuracy in your calculations to allow for this range. You can scale the convolution result (for example, divide each result by 2) if it is to go back into the image memory.

In a related issue, kernel values, and therefore the convolution output, can be positive or negative. Negative intensity is mathematically useful, but not physically reasonable in this case—you can't display negative intensity. You might want the option to modify the convolution output such that only positive values, or only negative values (negated to positive values), or absolute values, or signed values are output. This also means that an additional sign bit must be kept in the calculations. Thus, for 8-bit pixels and a 3 by 3 kernel, you need 12 bits for the sum and an additional bit for the sign.

At this point, you might agree that, while convolution is relatively simple, the implementation issues complicate it. This is unfortunately true of quite a few other image processing algorithms. For example, the issues of internal accuracy and what to do at the edge of the image appear in most other area processes. You must understand these issues to effectively implement and use the algorithms.

In the code fragment for a 3 by 3 convolution (see listing 5), you use a separate source (starting at x,y and of size dx,dy) and destination (starting at x_out, y_out and of the same size as dx,dy) areas in the image memory to avoid overlapping the output convolution values with the inputs to the convolution. The SIMPP convolution routine uses a more elaborate line-buffering method to allow an area to

continued

Listing 4: *This sample C code selectively changes a specified band of pixel values to be displayed in red, an example of a pseudocolor algorithm.*

```
/* Change the output LUTs to display the pixel values *
 * ranging from v_begin to v_end in red.              */
LUT_highlight(v_begin,v_end)
{
  int i;

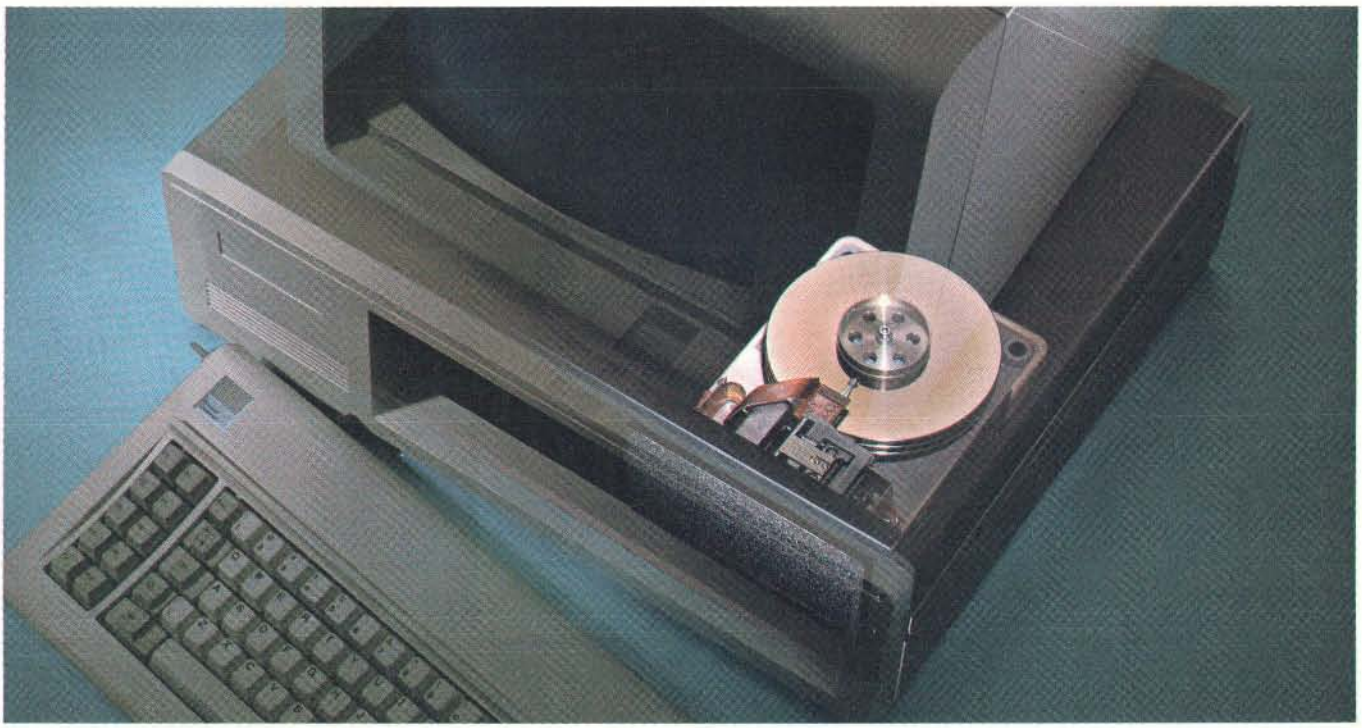
/* Set output tables to "linear".  This will display
   the image in normal, monochrome fashion */
  for (i = 0 ; i < 256 ; i++) {
      write_LUT(RED,i,i);
      write_LUT(GREEN,i,i);
      write_LUT(BLUE,i,i);
  }
/* Set the desired range so that ONLY red is displayed */
  for (i = v_begin ; i <= v_end ; i++) {
      write_LUT(RED,i,255);    /* Full red */
      write_LUT(GREEN,i,0);    /* No green */
      write_LUT(BLUE,i,0);     /* No blue */
  }
```

Listing 5: *A C code fragment for a 3 by 3 convolution algorithm that uses separate source and destination memories to avoid overlapping the output convolution values with the inputs to the convolution.*

```
/* Set up kernel for "sharpening" (high-frequency boosting)
   the image */
  static int kernel[9] = {-1,-1,-1,
                          -1, 9,-1,
                          -1,-1,-1,};

/* Increment starting position and decrement image size
   to accommodate the convolution edge effects */
  x++; y++; dx--; dy--;
/* Set up address offsets for the output */
  xx = 0; yy = 0;
/* Scan through source image, output to destination */
  for (i = y ; i < y+dy ; i++) {
     xx = 0;                    /* Reset x output index */
     for (j = x ; j < x+dx ; j++) {
      sum = 0;                  /* Zero convolution sum */
      k_pointer = kernel;       /* Pointer to kernel values */
/* Inner loop to do convolution (correlation!) */
      for ( n = -1 ; n <= 1 ; n++) {
        for (m = -1 ; m <= 1 ; m++)
            sum = sum + read_pixel(j+m,i+n)*(*k_pointer++);
      }
/* Output processing */
      if (sum < 0) sum = 0;
      write_pixel(x_out + xx, y_out + yy, sum);
      xx++;              /* Increment output X address offset */
    } yy++;              /* Increment output Y address offset */
  }
```

THE DRIVE THAT MAKES YOUR COMPUTER WORTH LOOKING INTO.



We'll let you in on a secret. If the small computer you're using has a hard disc drive memory, chances are that drive was made by Seagate.

There's a reason for this—actually over 4 million reasons. (That's the number of hard disc drives Seagate has shipped to quality-conscious customers throughout the world.)

Why are we telling you this?

So you can be sure you get Seagate quality in your new computer, disc memory upgrade or add-on.

The name on the outside may be different, but now that you know the difference, make certain that the name on the inside is SEAGATE.

Seagate Technology, 920 Disc Drive, Scotts Valley, CA 95066. 800-468-DISC (800-468-DISK in California)

Seagate

Inquiry 273 for End-Users. Inquiry 274 for DEALERS ONLY.



Photo 7: *An image of Devil's Tower National Monument in Wyoming, before image processing.*

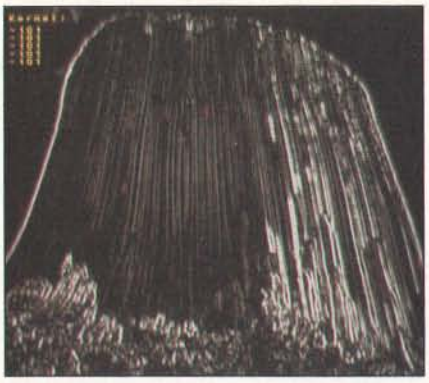


Photo 8: *Convolution of photo 7 with a kernel (shown in the upper left corner) that amplifies vertical edges.*



Photo 9: *Convolution of photo 7 with a kernel (shown in the upper left corner) that amplifies horizontal edges. As you can see, this image doesn't have many horizontal edges.*



Photo 10: *An image of rocks and trees in Yosemite National Park, before image processing.*



Photo 11: *Convolution of photo 10 with a Laplacian kernel (shown in the upper left corner). Edges are now outlined in white, and all other areas are dark.*



Photo 12: *The result of convolving the image in photo 10 with a sharpening kernel. This kernel (shown in the upper left corner) adds a Laplacian convolution to the original image in order to boost the higher spatial frequencies.*

be convolved into itself ("in place"). The output values are not scaled and negative output values are set to 0.

When I apply convolution to a problem in image processing, I generally think of it as either a matched filter or a spatial filter. In a matched filter, the convolution kernel is essentially a small image of what you want to amplify or detect. For example, suppose you want to amplify vertical edges in the image. An edge is represented in the image by a sudden increase or decrease in image intensity. A kernel like this

```
-1  0  1
-1  0  1
-1  0  1
-1  0  1
-1  0  1
```

looks like a little vertical edge. Note the effect of the negative values: In a uniform image area, where all pixel values input to the convolution are the same, the convolution output will be 0 (since the sum of any number times each of the 15 kernel elements is 0). I have padded the kernel with a vertical row of zeros to make it an odd size in both directions. This changes the properties of the kernel but is a computational convenience. The result of applying this kernel to the image shown in photo 7 is displayed in photo 8.

A similar kernel for amplifying horizontal edges would look like this:

```
-1  -1  -1  -1  -1
 0   0   0   0   0
 1   1   1   1   1
```

The result of applying this to the same image is shown in photo 9.

You can use larger kernels with a pattern (e.g., for the letter A) to detect similar patterns in the image. In this case, the kernel is often called a template, and you are really doing a correlation, as noted previously. Detection usually involves amplification of the desired feature followed by a yes/no decision that asks, "Is the result above or below a certain threshold point?"

A second view of convolution is that it performs spatial frequency filtering. In sound, frequency is the number of times per second a waveform repeats. In images, spatial frequency is the number of times per unit distance that a pattern repeats. As with a one-dimensional signal, an image can be broken down into a series of sine and cosine waves (or some other set of waveforms), and the spatial frequency specified for each. You can accomplish this by using a fast Fourier transform. The transform must be done both horizontally and vertically because you have spatial frequencies in both directions.

If you want to select and, perhaps,

detect a certain band of frequencies, you can build a kernel that selects that frequency. Quickly changing image intensities are represented by high spatial frequencies, while slowly changing intensities are represented by lower spatial frequencies. To select high spatial frequencies we could use the following kernel:

$$\begin{matrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{matrix}$$

This is often called a Laplacian filter because it approximates an unoriented second-derivative operation. The results of applying it to the image in photo 10 are shown in photo 11. Since edges have high spatial frequencies (sudden intensity changes), this kernel selects edges of any direction. It might be used as an "edge detector" for image analysis.

If you slightly modify the laplacian kernel by making the center kernel element 9 instead of 8, the result is the same as if you added the output of the laplacian convolution to the original image (since a kernel with a 1 in the middle would give you the source image back unchanged). This kernel selectively boosts high frequencies (edges), and the resulting image (photo 12) looks sharper and noisier. On the other hand, if you use a kernel that matches lower spatial frequencies, you will blur the image.

The power of convolution lies in using information in an area to make assertions about some property at an image point. For example, the edge operators shown above improve the estimate of "edgeness" at an image point by using the fact that physical edges extend over some distance. The art of convolving is in picking the right kernel. While these views of what the kernel does can get you started, experience and theory are necessary for creative convolving.

Nonlinear Area Processes

Convolution is easy to implement, use, and analyze because it is a linear operation—it requires only sums of first-degree products.

Nonlinear operations, while a bit harder, are also useful and can be more powerful than a convolution. By "powerful" I mean that they provide a better signal-to-noise ratio for detecting image elements or detecting features with less computation. Consider the following two examples of nonlinear area processes.

The Sobel filter compares the result of two convolutions to estimate the strength and orientation of edges in the image. If the two kernels, X and Y, are

continued

Attention all FX80, FX100, JX, RX, & MX owners:

You already own half of a great printer

Now Only $79.95

Dealer inquiries welcome.



Now for $79.95 you can own the rest. You see, today's new dot matrix printers offer a lot more features.

But now, a Dots-Perfect upgrade kit will make your printer work like the new models in minutes—at a fraction of their cost!

For example, with a Dots-Perfect the "dotty" look is gone! In its place is NLQ (Near Letter Quality), a feature that produces printed characters almost as sharp as a daisy wheel or laser printer.

NLQ: Like Having Two Printers

NLQ is not just "double striking." It's a completely redesigned letter form that reshapes each character. Characters are actually formed by four times the normal dot resolution.

And since NLQ can be switched on or off from the touch of a button, you can switch modes whenever you wish.

Installs In Minutes

You can install a Dots-Perfect in minutes with an ordinary screwdriver by following our easy-to-understand illustrated instructions.

All you need do is unplug the existing chips and replace them with a Dots-Perfect—that's all there is to it!

Doesn't Get In Your Way

Dots-Perfect is easy to operate because it actually becomes part of your printer.

It requires no software itself, so it can be used with every software package.

And you control it from the printer's existing control panel buttons.

You can choose from over 160 printing modes like condensed, double-wide, italic, high-speed draft, or even combinations. All switched on and off at the touch of a button.

Samples shown actual size

NLQ abcdefghiJKLM
Condensed Fine Print
Emphasized
Double-Wide
Italics Underline
Or Hundreds of Combinations!

Dots-Perfect even has a unique panel button controlled buffer clear command.

I.B.M. Graphics

FX, JX and MX versions of Dots-Perfect will even permit switching from the standard Epson® character set to the IBM®Graphics Printer set, allowing you to print IBM screens exactly as they appear on your computer. All three versions have all Graftrax Plus™ features, even the MX version.

And, every Dots-Perfect is backed with a full year's warranty.

So, call now toll-free and use your Visa, MasterCard, or American Express card.

Don't replace your printer, upgrade it!

1-800-368-7737
In California: 1-800-831-9772

Sample of letter with Dots-Perfect

Dots-Perfect™

Sample of letter without Dots-Perfect

Dresselhaus
837 E. Alosta Ave., Glendora, CA 91740 Tel: (818) 914-5831



An upgrade kit for EPSON FX, JX, RX, & MX printers

IBM is a registered trademark of International Business Machines Corp.
Graftrax PLUS is a trademark of Epson America, Inc.
Epson is a registered trademark of Epson America, Inc.

Inquiry 95



Photo 13: *The result of a Sobel operation on a map of the United States. Edge orientation is represented by color, and edge strength by color intensity. (Photo courtesy of Imaging Technology Inc.)*

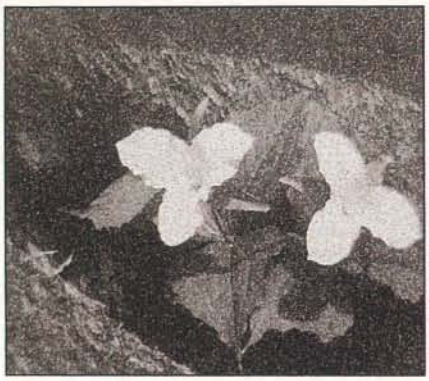


Photo 14: *An image of flowers with a large amount of random noise, which looks like salt and pepper scattered on the picture.*

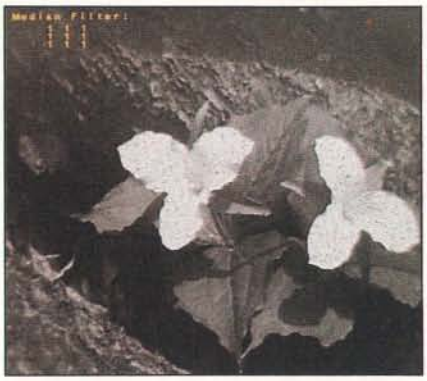


Photo 15: *Most of the noise in photo 14 was removed using a 3 by 3 median filter (shown in the upper left corner).*

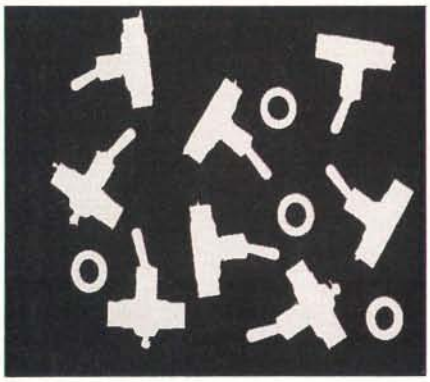


Photo 16: *A silhouette image of switches and grommets, obtained by placing the objects on a light table.*

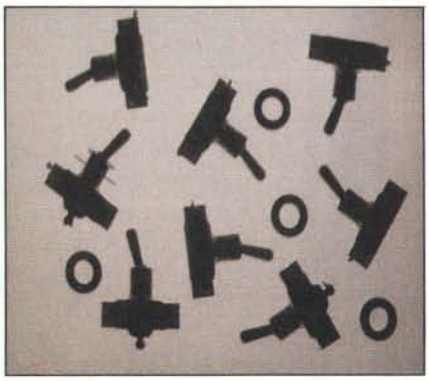


Photo 17: *A binary image of photo 16, made using a point process.*



Photo 18: *The various objects in photo 17 have been labeled with different pixel values. Lookup tables were then used to show the different values in color, a technique known as pseudocoloring.*

	−1	0	1		1	2	1
X:	−2	0	2	Y:	0	0	0
	−1	0	1		−1	−2	−1

then the edge strength and orientation are represented by

$$\text{strength} = \sqrt{X*X + Y*Y}$$
$$\text{orientation} = \arctan(Y/X)$$

This is a first derivative (oriented) edge finder, and the vector field it produces cannot be directly shown on a two-dimensional image. Photo 13 represents edge strength by intensity and orientation by color. The Sobel is a good edge detector and is frequently used as the first step in machine-vision algorithms. Since the Sobel algorithm is computationally intensive, various approximations have been developed to implement it (see "Low-Cost Image Processing" by Charles McManis on page 191 for an example).

The median filter replaces the pixel at the center of a neighborhood of pixels with the median of the pixel values. The neighborhood values, including the center pixel, are sorted into ascending order and the median (middle) value is used to replace the center pixel. The effect of a median filter is to remove spot noise. The result of a median filter on photo 14 is shown in photo 15.

Classification

To classify image elements you need to supply your computer with additional knowledge as to what constitutes an image element. This knowledge can get elaborate, but a simple rule will suffice as an example: An element is a connected group of pixels with the same value. By connected, I mean that if the pixel has the same value as a neighbor at 0, 90, 180, or 270 degrees, it is part of the element group.

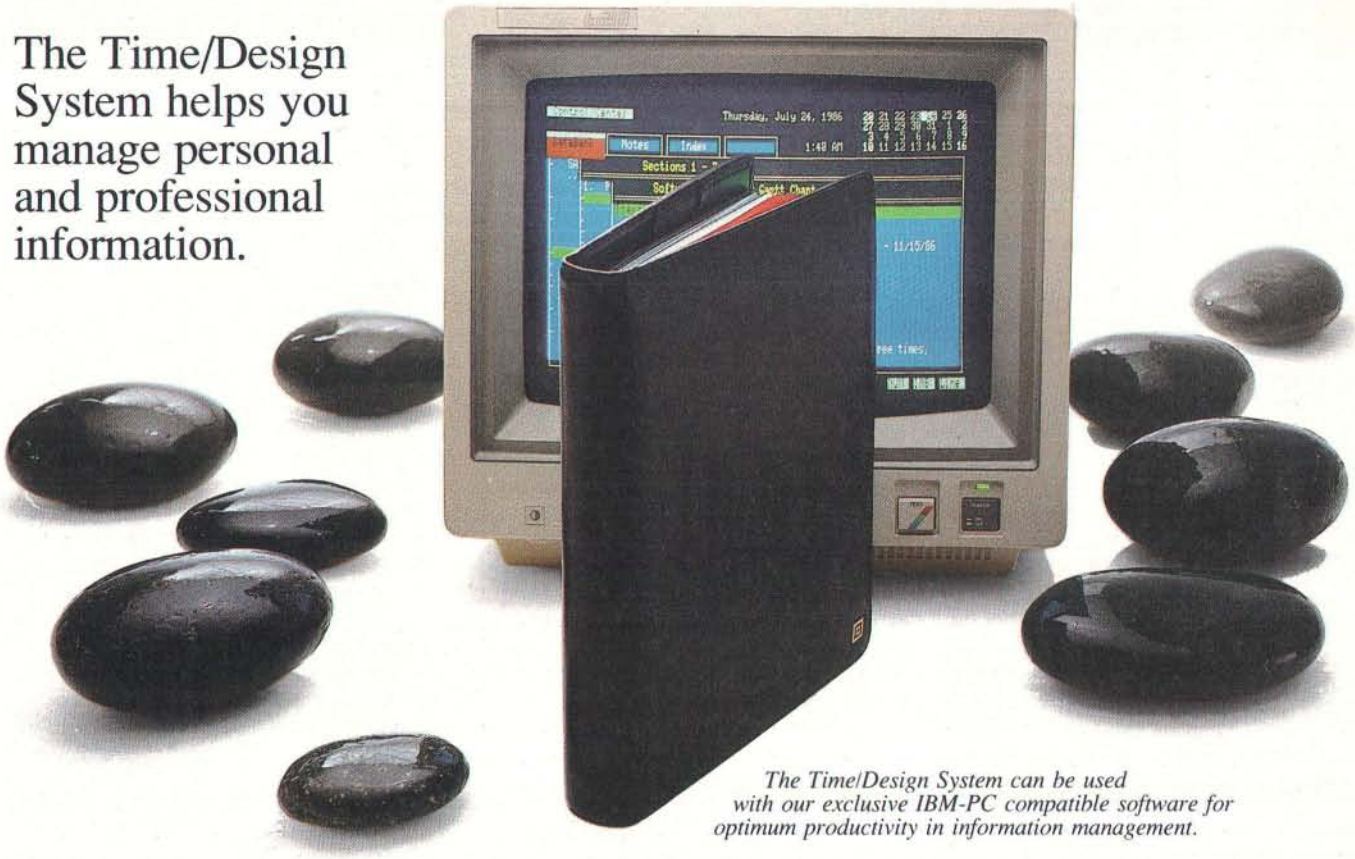
To simplify the computation you can "binarize" the image shown in photo 16. That is, you convert all pixel values below a threshold value to 0 and all those above the threshold value to 255 (photo 17). This is often done in machine vision, as you can control the lighting and objects to be viewed. You search this image from top to bottom, looking for areas that have more than *N* connected pixels. By requiring that the area have more than *N* pixels, you ignore the small spots of noise introduced by thresholding. Each area is labeled with a different pixel value. In photo 18, I have used pseudocolor to indicate the image elements I have classified. You can also record the number of pixels in an element and use this for further classification.

The most difficult part of implementing this example is finding all the connected pixels in an element. The simplest imple-

continued

Invent Your Future

The Time/Design System helps you manage personal and professional information.



The Time/Design System can be used with our exclusive IBM-PC compatible software for optimum productivity in information management.

It is a sophisticated time management system that supports short and long term planning, facilitates project management, and responds to the requirements of individuals and teams.

The Time/Design System promotes creative thinking in the most diverse and demanding management environments. It has a proven track record of success with thousands of individuals and corporations all over the world. And it is the only time management system in the the world to receive the same award as BMW and Braun for outstanding design.

The Time/Design System is part of a family of information management tools and services that bring clarity to complex and busy lives.

If your time is valuable, the Time/Design System is invaluable.



For further information call

Time/Design™

1(800) 637-9942, ext 90

2101 Wilshire Boulevard

Santa Monica, CA 90403

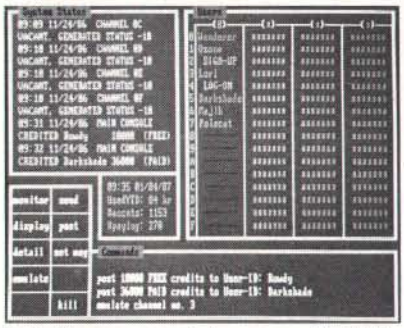
Inquiry 310 for End-Users. Inquiry 311 for DEALERS ONLY.

Inquiry 116

MULTI USER BBS

Off-the-shelf and custom systems for:

★ Multi-User Teleconferencing
★ Multi-User Electronic Mail
★ Multi-User File Upload/Download
★ Multi-User Order Entry
★ Multi-User Games and Amusements
★ Multi-User Database Lookup
★ Multi-User Online Expert Systems
★ Multi-User Catalog Scanning
★ Multi-User Classified Advertising
★ Multi-User Educational Services



What do you need for your Multi-User Bulletin Board System?

	Us	Them
16 modems on one card	YES	?
Up to 64-user capability	YES	?
Runs under MS-DOS V3.1	YES	?
C source code available	YES	?
Menu-oriented operation	YES	?
Accounting w/audit-trail	YES	?
Extensive SYSOP displays	YES	?
Powerfail-protected data	YES	?
"Midnite cleanup" option	YES	?
1-year hardware warranty	YES	?

We sell hardware and software for the IBM PC family and compatibles. Our product line is centered around the GALACTICOMM BREAKTHROUGH, a single-slot card with 16 independent modems on it. You will simply have a cable coming out the back of your machine, going straight into the jacks in the wall installed by the telephone company. No external hardware needed.

Call our multi-user demo system with your modem, at (305) 922-3901. Then call (305) 472-9560, voice, for more information. Why not call right now?

GALACTICOMM

GALACTICOMM, Inc., 11360 Tara Drive, Plantation, FL 33325

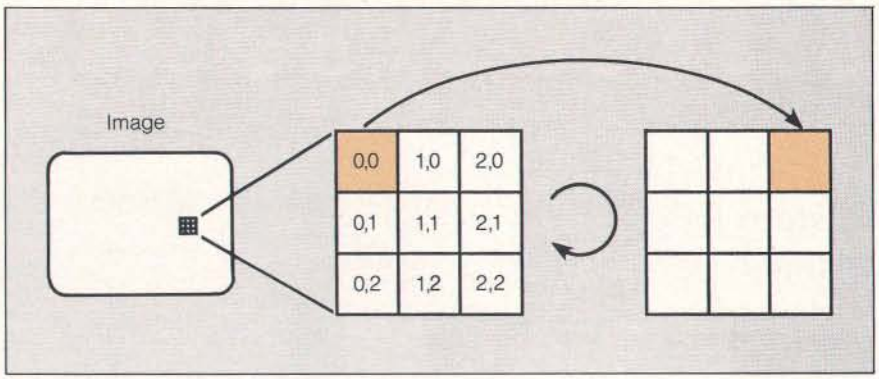


Figure 1: *In a geometric process of rotation by 90 degrees, a pixel at location 0,0 is mapped by the formulas x' = (YSIZE−1)−y and y' = x to the new location 2,0. (x' = (3−1)−0 = 2 and y' = 0.)*

mentation uses a recursive search (see listing 6) to find all connected pixels.

The program in listing 6 will quickly run out of stack space on most machines. In SIMPP, I used a more elaborate combination of recursion and iteration to reduce the chance of stack overflow. Listing 6 does not show boundary checking or deletion of elements with less than *N* pixels. You can easily add these.

Even though this algorithm changes the value of individual pixels, it does so based on an area property (connectedness), so I think of it as an area process. Most image-element classification schemes use both area and point processes to develop a list of properties that describes a multidimensional space. This space is then partitioned to perform the classification—similar to the way an image is thresholded to binarize it.

Geometric Processes

Geometric processes change the spatial arrangement of pixels. They are often used to correct for distortions caused by the camera optics or viewpoint, or to enlarge an image area of interest. Typical geometric processes rotate, stretch, translate the image position, or warp the image. Geometric algorithms can be expressed by a set of equations (a matrix) that maps a pixel at location *x,y* into a new address, x', y'. For example, to rotate a square area clockwise by 90 degrees, the pixels are mapped by: $x' = (YSIZE-1)-y$ and $y' = x$, as shown in figure 1.

Another simple implementation for rotation is to read horizontal lines of pixels from the source image and write out entire lines at the desired new angle. This doesn't work if the image is rotated in place—that is, if you use the same image memory area for source and destination. The problem is the same as with convolutions: The output pixels will be reused as inputs and the image will be jumbled. As before, you must use nonoverlapping source and destinations or copy the image into a memory buffer and use that as the source image.

The SIMPP rotate routine copies the image area to a memory buffer and then writes it out vertically to rotate the image by 90 degrees. The rotated area is limited to the maximum buffer size available. This is usually 64K bytes (2^{16}) on a 16-bit computer. If the CPU prefetches data, as the 8086 microprocessor does, then reading the last word in the 64K buffer can cause a prefetch beyond the end of the buffer, resulting in a hardware error if no memory is there. To be safe, reduce your buffer size to a few bytes less than the maximum buffer size allowed.

Most geometric transforms end up with gaps between the output pixels if you start with source pixels and place them in the destination area according to the transformation equations. (This is a problem with digitized images that would not occur with continuous-tone images such as photographic prints.) For example, if you enlarge an image area by a factor of 2 in *x* and *y*, the source pixels will be mapped to every other destination pixel and row. The solution is to invert (reverse) the mapping equations and scan the destination area. At each point in the destination, you use the inverted equations to fetch a source point. If you request a source point that lies between pixels in the source area, you must approximate the value by using the value at the nearest source pixel or by interpolating source values.

The code fragment in listing 7 shows how you can enlarge an image in the *x* and *y* directions by arbitrary factors. This uses the nearest neighbor to approximate values between source pixels and requires that the source and destination images do not overlap.

The nearest-neighbor approximation will produce sudden intensity changes in the image, giving it a blocky appearance.

continued

Aztec C ... The Best C
Frees the genius in you

You've got a great idea . . .
. . . you're ready to write your programs.

You don't want to be sidetracked by all the paperwork. With Manx Aztec C and the ingenious **make** function, your creative processes won't get bogged down in program administration and housekeeping. Manx Aztec C has the most sophisticated, hardworking program administrator available to you. Once you've described your project, adding new features or enhancements is simple. You never have to concern yourself with the repetitive, tedious task of rebuilding your systems.

The development process moves quickly. Compiles, assemblies, link edits . . . all finish in record time.

Manx Aztec C is the fastest, most efficient C development system in the industry. Benchmarks show it . . . reviews commend it . . . users praise it.

You're ready to test the program. You're ahead of schedule. The Manx Aztec C Source Level Debugger shows you the exact C language statement giving you a problem. You fix the problem quickly . . . you're still ahead of schedule.

You've got some time for fine tuning. The Manx Aztec C Profiler examines your program, tells you where the slow spots are and validates your test procedure. A few changes and it's exactly what you wanted.

You've made it!

Aztec C is available for MS-DOS/PC DOS. Call for details on Macintosh, Amiga, Apple II, CP/M-80, CP/M-86, TRS-80, ROM and others.

To order, or, for information

Call Today

1-800-221-0440

In NJ or outside the USA call (201) 542-2121

30-day satisfaction guarantee. Special Discounts are available to professors, students, independent developers, and on a "trade-in" basis. Site licenses.

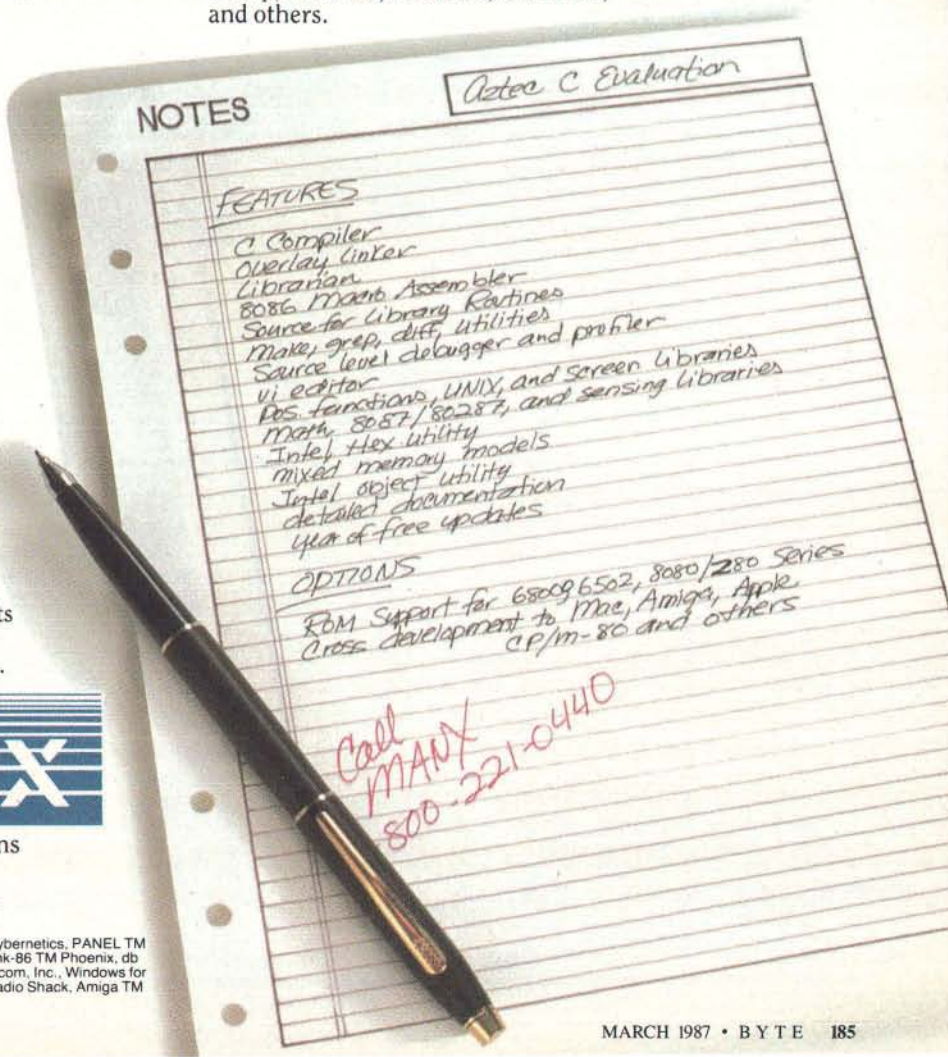
" . . . a superb linker, a profiler, an assembler, and a set of development utilities are only the beginning of this package . . . performed admirably on the benchmarks, with short compile times and the best link times in this review . . . includes the most professional make utility . . . documentation is clear and complete. There is no doubt that this is a valuable and powerful programming environment." **Computer Languages Feb. '86**

" . . . execution times are very good, close to the best on most tests . . . " **PC Tech Journal Jan. '86**

" Easily one of the fastest compilers overall . . . library provides a lot of flexibility . . . generates small .EXE files." **Dr. Dobbs Journal Aug. '85**

C'Prime (Compiler, Assembler, Linker)	**$ 99.**
Aztec C 86-d Developer's System	**$299.**
Aztec C 86-c Commercial System	**$499.**
PC ROM (8086, 68000, 8080, or 6502)	**$750.**

Third Party Software for Aztec C: HALO, PHACT, C-tree, PRE-C. Windows for C, PC-lint, PANEL, Greenleaf, db Vista, C-terp, Plink-86, FirsTime, C Util Lib, and others.



MANX

Manx Software Systems
One Industrial Way
Eatontown, NJ 07724

MS is a registered TM of Microsoft, Inc., CP/M TM DRI, HALO TM Media Cybernetics, PANEL TM Roundhill Computer Systems, Ltd., PHACT TM PHACT Assoc., PRE-C, Plink-86 TM Phoenix, db Vista TM Raima Corp., C-terp, PC-lint, TM Gimpel Software, C-tree TM Faircom, Inc., Windows for C TM Creative Solutions, Apple II, Macintosh TM Apple, Inc., TRS-80 TM Radio Shack, Amiga TM Commodore Int'l.

Interpolation produces smoother results. The SIMPP stretch routine uses interpolation and an internal buffer.

In many image processing systems, a pixel represents a rectangular rather than a square area, often because the processes deal with rectangular video images. To improve accuracy, you can compensate for rectangular pixels by adjusting the transformation equations. The implementation should also check for addresses beyond the limit of the image area.

Listing 6: *A C code fragment for an algorithm that searches for pixels with the same value as a neighbor at 0, 90, 180, or 270 degrees.*

```
/* Variables used in labeling */
  static int count;
  static int newval = 1;

/* Search image area for target values == 255 */
  for (y = 0 ; y < YSIZE ; y++) {
    for (x = 0 ; x < XSIZE ; x++) {
/* If we find a target value, recursively label
   the connected pixels with a new value (newval) */
      if (read_pixel(x,y) == 255) {
              count = 0;       /* Zero pixel count */
              recursive_label(x,y);
              newval ++j
      }
    }
  }

  recursive_label(x,y)
  {
      write_pixel(x,y,newval);      /* Replace with newval */
      count++;                      /* Increment count */

/* Recurse left */
      x--;
      if (read_pixel(x,y) == 255) recursive_label(x,y);
/* Recurse right */
      x += 2;
      if (read_pixel(x,y) == 255) recursive_label(x,y);
      x--;
/* Recurse up (remember: video coordinates!) */
      y--;
      if (read_pixel(x,y) == 255) recursive_label(x,y);
/* Recurse down */
      y += 2;
      if (read_pixel(x,y) == 255) recursive_label(x,y);
  }
```

Listing 7: *A C code fragment that enlarges an image in the x and y directions by arbitrary factors, an example of a geometric algorithm.*

```
  int xs,ys;  /* Start of source */
  int x,y;    /* Start of destination */
  int dx,dy;  /* Size of destination area */
  double a,b; /* x,y scale factors */
  xa,ya;      /* x and y addresses for source */

  for (i = 0 ; i < dy ; i++) {
    for (j = 0 ; j < dx ; j++) {
      xa = xs + (int)((double)j/a);   /* x address */
      ya = ys + (int)((double)i/b);   /* y address */
/* Write out new value to destination */
      write_pixel(x+j, y+i, read_pixel(xa,ya));
    }
  }
```

Frame Processes

Algorithms that use more than one image are sometimes called frame processes. A simple example is to subtract one image from another. The resulting differences can be used to compare the two images (e.g., to look for missing parts on a machine or circuit board). You can also use frame processes to improve image quality and to detect motion.

If you use a television camera to view a static image (e.g., a microscope image) you can sum N successive image frames to reduce noise introduced by the camera. This requires a frame memory with enough bits per pixel to accommodate the sum. Dividing the sum by N produces an averaged image. If the noise is Gaussian and uncorrelated from frame to frame, the improvement in signal-to-noise will be of order square root of N. A typical low-cost video camera has about 3 bits of noise, so averaging with an N of 8 or 16 will noticeably improve the image that is output to your display.

To detect motion, you can subtract video frames to approximate a time differentiation. You could use this operation for surveillance or motion measurement. This operation could require image processing hardware that can do the subtraction in real time, that is, at video rates.

Conclusion

As researchers try to give machines the ability to see, image processing becomes an increasingly important science. This quick tour of the algorithms and implementation will hopefully encourage you to learn more about image processing. You will find that you need to understand many other theoretical and technical issues (e.g., sampling procedures, lighting, and algorithm stability) to master image processing. A number of texts can help you (see the bibliography), but you can gain practical experience only by trying the algorithms. ■

BIBLIOGRAPHY

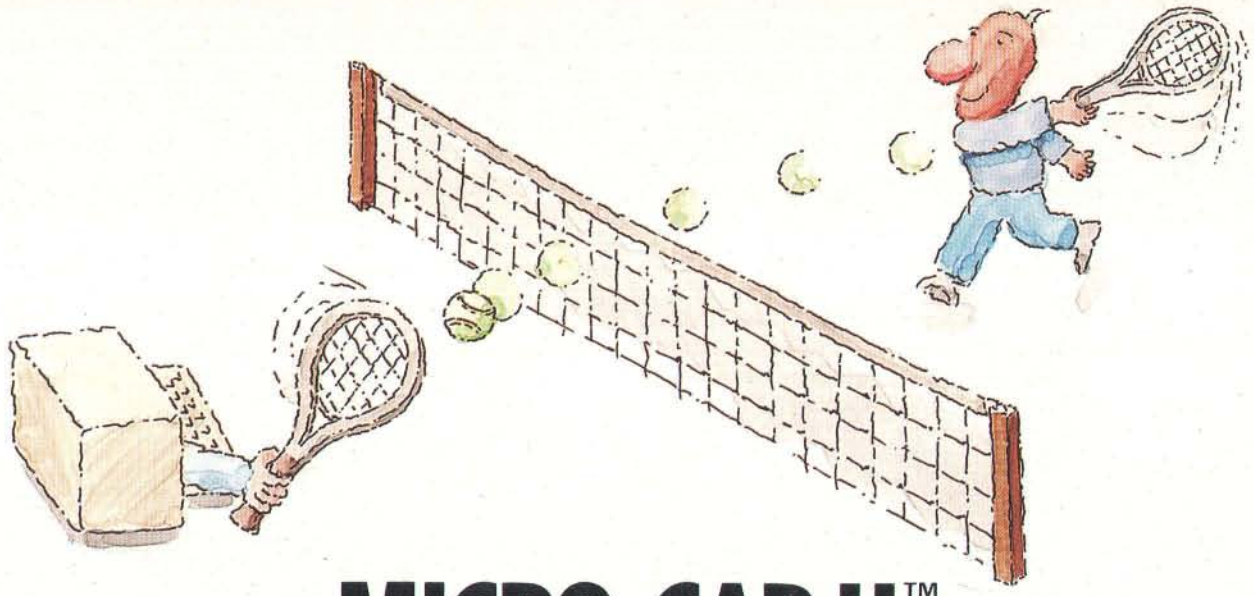
Baxes, G. *Digital Image Processing*. Englewood Cliffs, NJ: Prentice-Hall, 1983.

Castleman, K. R. *Digital Image Processing*. Englewood Cliffs, NJ: Prentice-Hall, 1979.

Newman, W. M., and R. F. Sproull. *Principles of Interactive Computer Graphics*. New York: McGraw-Hill, 1979.

Pratt, W. K. *Digital Image Processing*. New York: John Wiley & Sons, 1978.

Rosenfeld, A., and A. C. Kak. *Digital Picture Processing*, vols. 1 and 2. Orlando, FL: Academic Press, 1982.

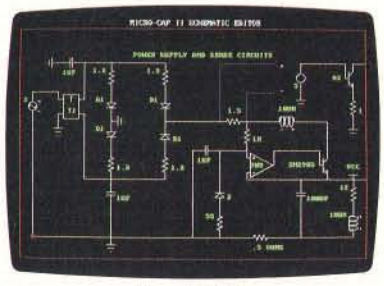


MICRO-CAP II.™

The CAE tool with fully interactive analog simulation for your PC.

Spectrum Software's MICRO-CAP II® is fast, powerful, and feature rich. This fully interactive, advanced electronic circuit analysis program helps engineers speed through analog problems right at their own PCs.

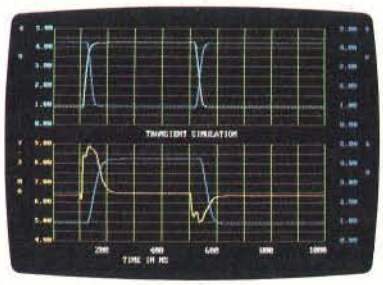
MICRO-CAP II, which is based on our original MICRO-CAP software, is a field-proven, second-generation program. But it's dramatically improved.



Schematic Editor

MICRO-CAP II has faster analysis routines. Better resolution and color. Larger libraries. All add up to a powerful, cost-effective CAE tool for your PC.

The program has a sophisticated integrated schematic editor with a pan capability. Just sketch and analyze. You can step



Transient Analysis

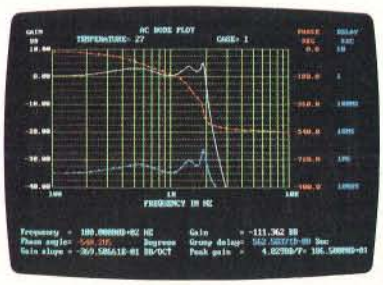
component values, and run worst-case scenarios—all interactively. And a 500-type* library of standard parts is at your fingertips for added flexiblity.

MICRO-CAP II is available for IBM® PCs and Macintosh.™ The IBM version is CGA, EGA, and Hercules® compatible and costs only $895 complete. An evaluation version is available for $100. Call or write today for our free brochure and demo disk. We'd like to tell you more about analog solutions in the fast lane.

- Integrated schematic editor
- Fast analysis routines
- High-resolution graphic output
- Standard parts library of 500* types

*IBM versions only.

- Transient, AC, DC, and FFT routines
- Op-amp and switch models
- Spec-sheet-to model converter*
- Printer and plotter* hard copy



AC Analysis

spectrum

1021 S. Wolfe Road, Dept. E
Sunnyvale, CA 94087
(408) 738-4387

MICRO-CAP II is a registered trademark of Spectrum Software.

Macintosh is a trademark of McIntosh Laboratory, Inc. and is being used with express permission of its owner.

Hercules is a registered trademark of Hercules Computer Technology

IBM is a registered trademark of International Business Machines, Inc.

CONSTANT COMMITMENT

Complete management tool

There are enough copies of Symphony® software in use today to make Symphony, by itself, the fourth largest independent microcomputer software company in the world. Now let's discuss why.

It's a truly complete workstation for the modern manager...incorporating 1-2-3's® powerful spreadsheet capability with Symphony's own word processing, graphics, database and communications. All of them working together, all in one program.

As your computer knowledge grows, so Symphony grows. The more you use Symphony, the more you find you can do with it. And with a growing line of Symphony add-in products from Lotus® (Text Outliner, Spelling Checker, Symphony Link™ etc.), Symphony offers steady and seemingly endless potential for expansion.

A workstation. Thoroughly integrated. Geared for growth.

That's why Symphony is one of the world's most successful business software programs for IBM® personal computers and compatible products.

And that's why you ought to get a complete demonstration.

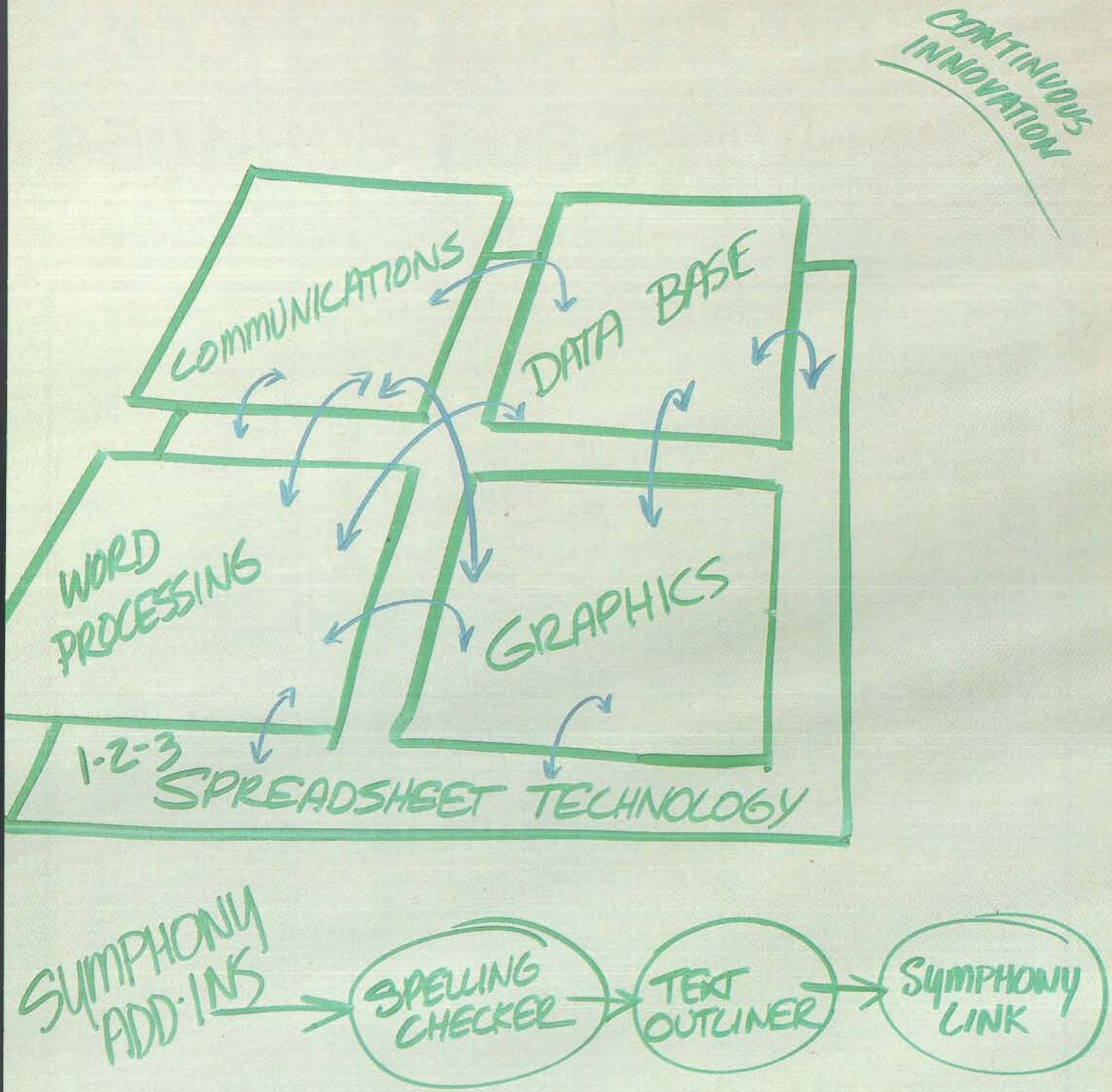
Lotus Symphony

A complete general-purpose software tool built around the world's leading spreadsheet technology.

© 1987 Lotus Development Corporation. Lotus, 1-2-3 and Symphony are registered trademarks of Lotus Development Corporation. Symphony Link is a trademark of Lotus Development Corporation. IBM is a registered trademark of International Business Machines Corporation.

you can't out grow it




CONTINUOUS INNOVATION
COMMUNICATIONS
DATA BASE
WORD PROCESSING
GRAPHICS
1-2-3 SPREADSHEET TECHNOLOGY
SYMPHONY ADD-INS
SPELLING CHECKER
TEXT OUTLINER
SYMPHONY LINK

COMPUTER WAREHOUSE

CALL TOLL FREE 1-800-528-1054

FREE FEDERAL EXPRESS® **Air Express Shipping**
See Details Below

NOW BEST PRICES
No Charge for Bank Cards

HARDWARE

PRINTERS

Alps 2000	$715
2100	$1145
Brother All Models	Call
Citizen MSP-10	$260
MSP-15	$379
MSP-20	$319
MSP-25	$475
Premier 35	$475
Diablo D-25	$469
635	$765
EPSON All Printer Models	Call
IBM Proprinter	$399
NEC	
3510, 3550	$729
8810, 8850	$1045
P5	$959
P6	$429
P7	$609
OKIDATA All Printer Models	Call
Panasonic 1080 I	$195
1091 I	$259
1092 I	$319
1592	$409
3131	$245
3151	$385
STAR MICRONICS All Printer Models	Call
Toshiba 321 Parallel & Serial	$455
341E Parallel	$669
351 Model II	$1045
Laser Printer	Call

DISKETTES

Maxell M2S (Qty 100)	$85
Sony MD/2 (Qty 100)	$85

MONITORS

Amdex All Monitors	Call
NEC Multisync	$575
Multisync Graphic Board	Call
Princeton Graphics	Call
Zenith All Models	Call

VIDEO TERMINALS

Qume QVT Green 101	$299
QVT Amber 101	$314
Wyse 30	$295
50	$369
75	$559
Wyse 85	$439
Wyse 350	$859
Zenith	
All Monitors	Call

MODEMS

Anchor Automation	
Signalman Express	$185
Practical Peripherals	
Practical 1200 Baud	$124
HAYES All Modems	Call
Prometheus All Models	Call
US Robotics Courier 2400	$349
Password 1200	$165
Microlink 2400	$349
Ventel	Call

DISK DRIVES

Iomega Bernoulli 10 meg	$1195
Bernoulli 20 meg	$1595
Bernoulli 40 meg	$2325
SEAGATE 20 meg w/Western I/O	$385

BOARDS

AST All Boards	Call
Hercules Color Card	$149
Graphic Card	$179
Intel Above Board PS/PC (1110)	$239
Above Board AT (2010)	$329
Above Board PS/AT (2110)	$369
Above Board PC	$210
NEC Multisync Graphic Board	Call
Orchid Tiny Turbo 286	$415
Turbo EGA	$565
Paradise Five Pak	$99
EGA Autoswitch	$359
Plus Development	
Plus Hard Card 20 Megabyte	$609
Quadram Quad EGA+	$359
Tec Mar Graphics Master	$409
Captain No Memory	$109
EGA Master	$239
Video-7 Vega Deluxe	$335
Vega Enhanced Graphics Adapt	$279



256 Memory, One 360K Brand Name Floppy Drive • 135 Watt Power Supply, Slide Case, AT Style Keyboard • 8 MHz Clock Speed, (Keyboard Selectable), 8 Expansion Slots

COMPUTERS

IBM

PC 1 Drive 256K	$1199
XT 1 Drive 256K	$1729
XT 1 Drive 20 Meg 640K	$2169
AT/68	$2849
AT/339	$4449

COMPAQ

Portable II—2 Drive	$1649

PANASONIC

Business Partner	$819
Sr. Partner	$979
Exec. Partner	$1309
Other Models	Call

TOSHIBA

T-1100	$1299
T-1100 Plus	$1619
T-3100	$3049

Zenith Computer Products
SAVE Up to 50%
All Models ..... Call

PLOTTERS

Epson Hi-80	Call

KEYBOARDS

Keytronics 5151	$159

COPIERS



Canon (PC)

Canon PC-25	$929

SOFTWARE

IBM PC and 100% Compatibles

TRAINING

Flight Simulator	$28
PC Logo	$69
Typing Instructor	$27
Typing Tutor III	$27
MS Learning DOS	$28

LANGUAGES

C Compiler (Microsoft)	$249
Fortran Compiler (Microsoft)	$195
Lattice C Compiler	$236
Macro Assembler (Microsoft)	$84
Pascal Compiler (Microsoft)	$166
Quick Basic 2	$55
Turbo Pascal w/8087 & BCD	$55
Turbo Database Tool Box	$38
Turbo Prolog	$54

PROJECT MANAGEMENT

Harvard Total Project Manager	$235
Microsoft Project	$219
Super Project Plus	$269
Timeline 2.0	Call

COMMUNICATIONS

CompuServe Starter Kit	$19
Crosstalk XVI	$88
MS Access	$139
Mirror	$38
Remote	$88
Smartcom II	$82

INTEGRATIVE SOFTWARE

Enable 1.1	Call
Framework II	Call
Smart Software System	$399
Symphony	Call
Ability	$55

GRAPHICS

Chartmaster	Call
Diagram Master	Call
Energraphics 2.0	$269
In-A-Vision	$259
Microsoft Buss Mouse 6.0	$106
Microsoft Chart	$164
Microsoft Serial Mouse 6.0	$119
Newsroom	$31
PC Buss Plus Mouse w/Paint Plus	$115
PC Mouse w/Dr. Halo II	$99
Click Art Personal Publisher	$99
IMSI Mouse w/Dr. Halo II	$99
PC Paint w/Mouse	$115
Printmaster	$29
Signmaster	Call
Turbo Graphix Tool Box	$38

WORD PROCESSORS

Leading Edge Word Processor	$19
Leading Edge W/P w/Spell & Mail	$32
Lightening	$55
Microsoft Word 3.1	$249
Multimate Advantage	$299
Wordstar w/Tutor	$162
Wordstar Pro Pack	$233
PFS: Professional Write	$95

Word Perfect (Ver.4.2) $199
Wordstar 2000 + 2.0 $278

SPREADSHEETS

Lotus 1-2-3	Call
Multiplan	$108
Spreadsheet Auditor 3.0	$82
VP Planner	$47

Supercalc 4 ..... $269

MONEY MANAGEMENT

Dollars & Sense w/Forcast	$92
Tobias Managing Your Money	$105

UTILITIES

MS Windows	$55
Copy II PC	$19
1 DIR Plus	$46
Fastback	$84
Norton Utilities 3.1	$48
Printworks	$36
Sidekick (Unprotected)	$47
Travelling Sidekick	$39
Sideways 3.1	$34
Superkey	$39
Xtree	$27
SQZ	$58

DATA BASE MANAGEMENT

Clipper	$329
Cornerstone	$55
dBase II	Call
dBase III Plus	Call
Extended Report Writer	Call
Knowledgeman II PromoPack	$295
Quickcode Plus	$138
QuickReport	$138
Reflex	$82
Think Tank	$91
PFS: Professional File	$119

R:Base 5000
System V $355

Many other titles available.

Inquiry 73 for MS DOS Products. Inquiry 74 for all others.

COMPUTER WAREHOUSE

Order Line: 1-800-528-1054
Order Processing: 602-224-9345

2222 E. Indian School Rd.
Phoenix, Arizona 85016
602-954-6109

Store Hours: Mon-Fri 10-5:30
Saturday 9-1
Order Line Hours: Mon-Fri 7-5:30
Saturday 9-1
Order Processing Hours: Mon-Fri 10-3

Product shipped in factory cartons with manufacturer's warranty. Please add $6.00 per order for UPS ground shipping on orders up to 10 lbs. Orders 10 lbs. and under you pay for ground service, receive air service at no extra charge. Available on orders 11-30 lbs. $17 for air service. Prices & availability subject to change without notice. Send cashier's check or money order...all other checks will delay shipping two weeks.

VISA MasterCard AMERICAN EXPRESS

CWF-187

Low-Cost Image Processing

An inexpensive but powerful image processing workstation can be built around the Amiga

Charles McManis

IMAGE PROCESSING consists of using a computer to manipulate digitized continuous-tone images. An image processing workstation must provide three basic facilities: the means to digitize, display, and manipulate the image data. The workstation might also provide a means of storing and distributing that data.

Not long ago, an image processing workstation could easily cost over $100,000. Now, with some innovative hardware and software, you can build a capable system for less than $2500. I will describe such a workstation based on the Amiga 1000 personal computer.

The Workstation

The hardware for this workstation consists of an Amiga 1000 computer with 1 megabyte of RAM and two disk drives, a DigiView video digitizer, and a black-and-white video camera. Optional equipment includes such items as a 35mm camera or videotape recorder for capturing your output and a copy stand for increasing the stability of the digitizing setup.

The Amiga computer provides the basis for the workstation. It is uniquely suited to image processing because of its high-resolution graphics, easily expandable memory, and ability to address large data arrays.

The Amiga's custom graphics chips can display an image that has 640 columns by 400 rows of 4-bit pixels. At this writing, this is the highest display resolution that is standard with a personal computer. The only other personal computer that comes close is an IBM PC equipped with the Enhanced Graphics Adapter, which has a maximum resolution of 640 columns by 350 rows of 6-bit pixels. (Thus, each pixel can have 64 possible colors.) While this setup appears to have a better pixel dynamic range (6 bits versus 4 bits), you can map the Amiga's pixels through the use of a palette RAM to any 16 of 4096 possible colors. The EGA's 64 colors are fixed, making it difficult to display either monochrome or color continuous-tone images acceptably.

The Amiga's architecture allows for easy access to large amounts of memory. This might be the most important aspect of using an Amiga as an image processing workstation. First, the Amiga uses a Motorola 68000, which addresses memory as a linear array of words. This feature lets you load an image completely into memory and treat it simply as a large array via a high-level language or an assembly language program. Second, adding memory is simply a matter of plugging a card into an expansion-bus connector on the side of the machine. For this article I have been using an Alegra 512K/2M that can be configured with either 512K bytes or 2 megabytes of RAM; mine has 512K. You can buy 2- and 4-megabyte cards, and you can often daisy-chain cards or plug them into expansion boxes to fully populate the 8 megabytes of address space reserved for user RAM.

On the IBM PC, adding multiple megabytes of memory is a simple matter of plugging memory cards into the internal bus. However, the original PC (and even the PC AT with current versions of MS-DOS) cannot directly access more than 640K bytes of RAM. (Various software and hardware manufacturers provide ways around this, but these all tend to be non-standard, are hard to call from a program, and slow down access to memory.) Manipulating images in the restricted 640K-byte address space is difficult at best.

The Amiga is also easier to program for image processing applications because of the way it addresses memory. Specifically, to declare an array of 128,000 bytes on the Amiga in C, you can use the following syntax:

```
unsigned char     *image;
image = AllocMem(128000,0);
```

Due to the nature of the architecture, arrays larger than 64,535 bytes are difficult to manipulate on the IBM PC and compatibles. Fortunately, this will not be the case for 80386-based machines.

Thus, the Amiga's cost, architecture, and inherent graphics capabilities give it the most favorable price/performance position for image processing applications.

Capturing Images

Before you can display and manipulate an image, you need to *have* an image. You solve that problem with a piece of hard-

continued

Charles McManis (1141 Vasquez Ave., Sunnyvale, CA 94086) is an engineer with Sun Microsystems. He received his B.S.E.E. from the University of Southern California in 1983 and has been programming computers professionally since 1976.

Image processing applications could be written in BASIC, but they would be slow.

ware such as the Digi-View from NewTek. This device connects a standard black-and-white video camera and the Amiga's parallel port. When you combine some software and this hardware, the complete digitization setup costs less than $400, including a black-and-white camera. (NewTek sells a Panasonic CCTV Model WV-1410 camera, which it provided along with the Digi-View for this article.) This package can digitize black-and-white images at resolutions of 640 by 400 or 320 by 200, with 16 shades of gray, or color images with resolutions of 320 by 200.

This setup has two color modes for digitizing. The first uses the Amiga's 32-color palette to display color images; the second uses the Amiga's "Hold and Modify" mode to display an image with 4096 colors on the screen. I used the 640 by 400 black-and-white mode exclusively.

The Software

Two types of software contribute to the Amiga's viability as an image processing workstation. The first type includes the common image processing languages such as C, FORTRAN 77, and LISP. Some of the newer languages are also available for the Amiga, including FORTH, Modula-2, and Pascal. You could also write image processing applications in the BASIC dialect supplied with the machine, but such programs would tend to be rather slow.

Several tools exist for manipulating image and graphical data. Some of these were written by Electronic Arts and contributed to the public domain along with the Interchange File Format specification. Others were designed for graphics manipulation but are useful here as well. All the IFF tools that I used are on the IFF distribution disk, which is available from Commodore and many bulletin boards around the country. Information on how to acquire a copy appears at the end of this article.

The IFF standard is complex because it is so flexible—it will describe music, text, animation, and so on. The IFF tools ILBM2Raw and Raw2ILBM (ILBM stands for interleave bit map) convert the complex IFF format images into a much simpler "raw" format, and vice versa. The raw format for 640 by 400 images consists of 4 bitplanes, each of which is 640 by 400 bits, followed by a 16-word color-map array with no header or other information.

As adjuncts to the tools from the IFF disk, I wrote two C routines, ReadImage( ) and WriteImage( ), to handle images in the raw format. These routines provide for reading and writing raw images, while Pixel( ) and SetPixel( ) provide for reading and setting individual pixels in an image. [Editor's note: *The programs described in this article are available on disk, in print, and on BIX; see the insert card following page 352. They are also available on BYTEnet; see page 4. The files are IMAGEIO.C and EDGE.C. You will need an Amiga and Lattice C to use them.*]

When you are finished processing a file, you can convert it back to IFF form and use it with other programs.

Using the System

The typical flow for image processing research is generally a six-step process. The steps are acquiring a digitized image, developing an algorithm to process it, processing the image, comparing the output with the desired results, modifying the algorithm, and looping back to the third step until you are satisfied.

I will cover each step to demonstrate how to use the Amiga as an image processing workstation.

Acquiring the Image

Operation of the Digi-View is straightforward. After starting the high-resolution

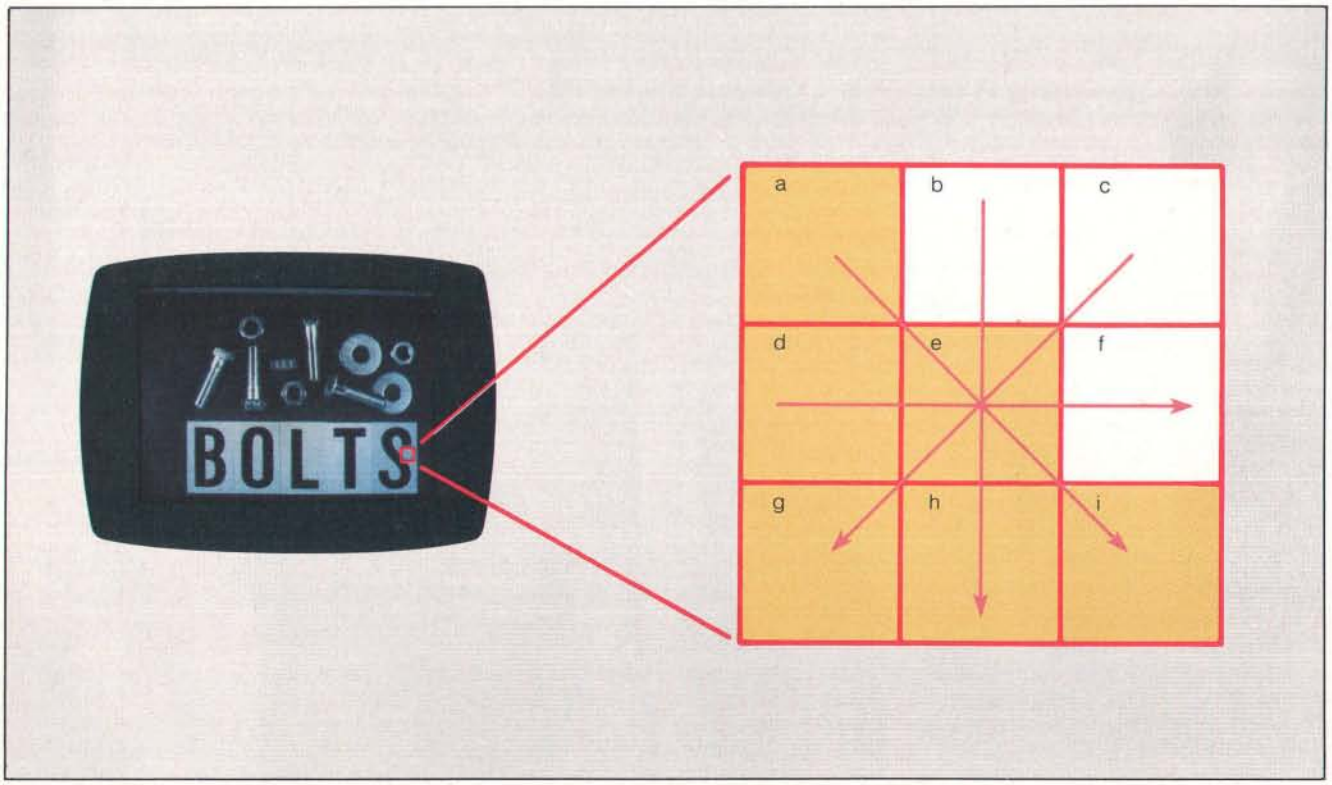


Figure 1: *The Sobel algorithm for image processing breaks arrays of pixels into 3 by 3 subarrays.*

version of the Digi-View software, you focus the video camera on the image to be digitized. Then select the Digitize option, and the image will be digitized into memory.

At this point, the software lets you manipulate the image data in several useful ways. These include adjusting the image's contrast, brightness, and sharpness. Once the image is adjusted to your satisfaction, you save it with the Save IFF option in the Project menu. The IFF format is needlessly complex for the purposes of image processing, so you then use the ILBM2Raw IFF tool from the Amiga's command-line interface to convert the image into the simpler raw form.

Developing the Algorithm

For this article, I have used a derivative of the Sobel edge-detection algorithm. The classic Sobel algorithm creates an edge image by calculating the two-dimensional derivative of the source image. The algorithm calculates this derivative by looking at each pixel in the source image and its eight nearest neighbors. The pixel of interest and its neighbors are treated as a 3 by 3 array (see figure 1). Using row and column coordinates, you can draw exactly four unique lines through the pixel at the center of this array. These are a-e-i, b-e-h, c-e-g, and d-e-f.

The algorithm averages the intensities of the three pixels on either side of each of these lines (for the line d-e-f, for example, it would compare the average of the pixels a, b, and c with the average of pixels g, h, and i). The algorithm then replaces the center pixel with the largest absolute difference of the four averaging operations. After completely building a new edge image in this manner, the program runs the image through a threshold filter. The filter examines each pixel and assigns a 0 or 1 to it, depending on whether its value is above a given threshold. In this binary image, all "on" pixels represent edges greater than the given threshold.

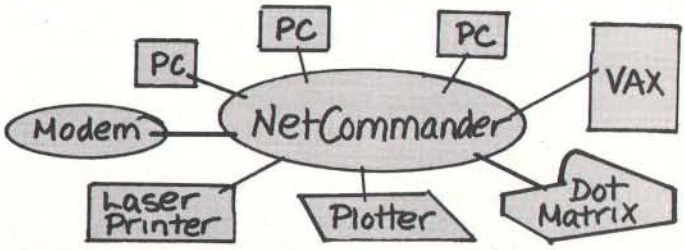
Unfortunately, this algorithm has two serious drawbacks. The first is its slowness; analyzing each pixel during the thresholding operation requires 16 additions and 8 divisions followed later by one magnitude comparison.

The second problem is noise. The Digi-View provides remarkably clean images, but the camera is susceptible to a certain amount of Gaussian noise (caused by the occasional spontaneous emission of electrons from the excitation of the phosphor on the face of the Vidicon tube). This noise manifests itself as individual pixels with intensities that are much higher or much lower than their neighbors. When

continued

Inquiry 87

20% LAN Price
90% Performance



NetCommander sub-LAN is an affordable network solution. For 20% of the cost, you get 90% of the functionality of a full LAN.

- ☐ the ultimate in printer sharing to cost justify expensive printers
- ☐ error-free, peer-to-peer file transfer
- ☐ buffering, up to one megabyte and port contention/selection
- ☐ 4, 8, 16 and 30 port models

Digital Products Inc., 108 Water Street, Watertown, MA 02172
617-924-1680 Outside Massachusetts, Call 1-800-243-2333

NetCommander

Choose Power Commander II®
Computer Power Control Center
for appearance, convenience,
and, above all, protection.



Tele-Line™ protection for modems, answering machines, etc.
Anti-Static Touchplate grounds hazardous static
Power Minder™ warning light for momentary sags and surges
Automatic Over-voltage Protection against damaging high line voltage
Overcurrent protection with resettable circuit breaker

- Simplifies on/off operations of computer and four peripherals, individually with 5 lighted switches, or all together with a master switch; ends power cord confusion and tangles
- Protects your equipment from data disturbances and damage from transient surges caused by lightning and utility switching; unique hybrid filtering circuit responds to clamp spikes in 5 pico-seconds, 1000 times faster than typical surge suppressors!
- Low let-through voltage—less than 300 V.
- Reduces EMI/RFI noise from power lines and power supply cords
- Patented failsafe Automatic Shutdown protection cuts off all power if the protective filtering circuit wears out or burns out, so your computer is never vulnerable to unprotected operation*.
- Five outlets, 15 Amp total. 12-foot power cord. Attractive putty color case. Five-year warranty.

Insist on complete protection...with the Number One rated Perma Power Power Commander II®, at computer stores and office supply dealers nationwide.

*Patent No. 4,577,578

PERMA POWER® Electronics INC.
5601 West Howard Avenue • Chicago, Illinois 60648
Telephone (312) 647-9414 Telex: 4948559 PRMPWR

Inquiry 229

Inquiry 145

DRIVE INN

Enclosures & power supplies for **FLOPPY, WINCHESTER, TAPE DRIVES, SINGLE BOARD COMPUTERS & S-100 SYSTEMS.**

8 inch
5 inch
3 inch

CUSTOMIZING AVAILABLE

Call or write for free catalogs and application assistance.



INTEGRAND

RESEARCH CORPORATION
8620 Roosevelt Ave. • Visalia, CA 93291
209/651-1203

TELEX 5106012830 (INTEGRAND UD)
EZLINK 62926572

We accept BankAmericard/VISA and MasterCard

you are using the Sobel algorithm, this noise can throw off the averages for the three pixel groups.

One solution to the noise problem is to obtain an image with less noise. NewTek has modified the newer version of the digitizing software to accomplish that by averaging several frames arriving from the camera. The other solution would be to increase the size of the pixel array to 5 by 5; however, this would slow it down still further.

To combat the speed problem, I modified the Sobel algorithm to consider the endpoints of each line, rather than the averages used in the original algorithm. The new algorithm compares the absolute magnitude of the change in intensity between these two points to a user-specified threshold value. If this threshold is exceeded, the algorithm sets the corresponding pixel in the destination image to indicate an edge and does no further analysis on that pixel. If none of the four possible

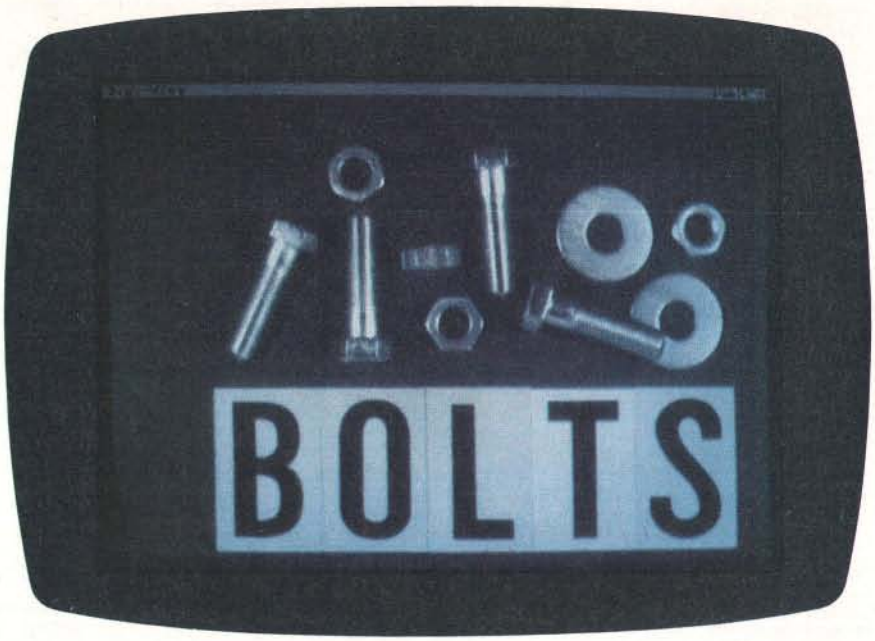


Photo 1: *The original image as digitized by the Digi-View.*

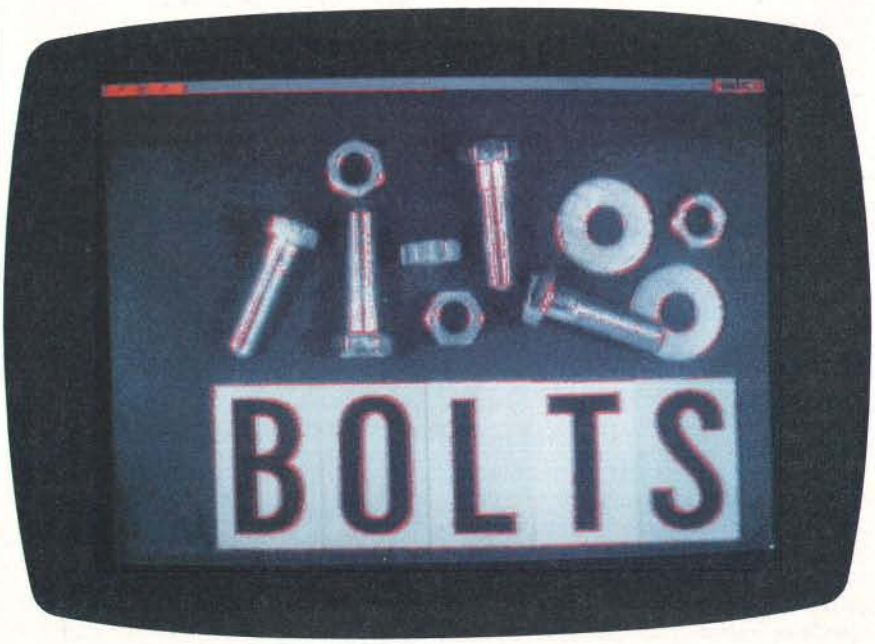


Photo 2: *The image of photo 1, edge-detected by the image processing program described in the text, with the threshold set to 2.*

magnitudes exceeds the threshold, the pixel value of the source image is copied into the destination image. This yields a resultant image with the edges detected by the algorithm overlayed onto the original image. It also yields a processed image in about one-sixth the time.

Process the Image

The program that implements this algorithm and processes the image is called EDGE.C. It uses the routines from the IMAGEIO module to manipulate the image in memory and to move the image to and from the disk.

Comparing Output with Desired Results

Photos 1, 2, and 3 show the input, the output with a threshold value of 2, and the output with a threshold of 4, respectively. I first ran these images through the Raw2ILBM tool to convert them to IFF format and then used SeeILBM to display them.

As you can see from the photos, the program tracks sharp changes in intensity as edges. With additional software, you can combine the edges into wire-frame drawings of the objects in the image. This is one way to reduce the amount of information a vision system would need to process in order to identify objects in its field of view.

Modifying the Algorithm and Continuing

This edge algorithm is not perfect—it sometimes detects edges that are just spots and might miss gradual edges. The algorithm also does not use information such as which line of symmetry the edge lies on or how large a difference the edge represents. Both would be useful clues that a vision system could use to identify edge directions and ignore false edge indications.

Saving Your Work

You can approach this aspect of the setup in three ways. The most straightforward is to use the Amiga as a viewing device and store the processed images in disk files.

The Amiga has a composite video output port that conforms to the NTSC video specification. You can use this to record what is on the screen onto a video tape—display an image, record it, pause, set up a new image, record it, pause, and so on. Then you can take the videotape on the road and use it as a magnetic "slide carousel." This is much more convenient than lugging around a heavy computer, monitor, disk drive, software, and so on.

You can also approach the hard-copy issue in three ways. The first is to photograph the screen with a camera. I used this technique for the pictures in this article. The second is to use a "video printer" such as the Polaroid Palette. This has the added benefit of ensuring a good exposure since it eliminates errors due to screen reflections or alignment. The last is to use the Amiga's ability to dump graphics to any graphics printer connected to the printer port. Depending on your printer, this can be the least satisfactory method.

The program tracks sharp changes in intensity as edges, which, with additional software, could be combined into wire-frame drawings.

A Powerful Combination

The combination of the Amiga and the NewTek digitizer is a powerful one. I have covered only the case of black-and-white images, but the hardware is capable of color, which adds another level of complexity to the system. The existing system provides enough power for many different types of image processing applications.

It also provides an easy path to increase that power. Multi-megabyte memory cards, math coprocessor cards, hard disks, and even 68020 accelerator cards are all available for the Amiga. They all increase the machine's speed and capabilities.

About the System

The IFF tools mentioned in this article are available from BIX, BYTEnet Listings, Commodore, or Fred Fish (who maintains a library of public domain software for the Amiga). To get them from Commodore, send a check for $20 and a note requesting the "Standard for Interchange Format Files (EA IFF) Documentation and Disk" to Commodore Business Machines, 1200 Wilson Dr., West Chester, PA 19380, attention: Kim Montgomery.

To get the tools from Fred Fish, send a check for $6 and a note asking for "Volume 16" to Fred Fish, 1346 West 10th Place, Tempe, AZ 85281. Your local users group or dealer might also have the tools as "Fish Disk 16." All of these tools are in the public domain.

The other software I used in this article includes the C compiler 3.10 from Lattice Inc., and the Digi-View software 1.0 that came with the Digi-View.

The hardware was an Amiga 1000 with an Alegra 512K RAM expander and a MicroBotics MAS-20 hard disk drive, the Digi-View unit, and a Panasonic CCTV Model WV-1410 video camera. I took photos with a Canon AE-1 35mm SLR camera, using Kodak Ektachrome 100 film shot at 1/15 second with an F-stop of 2.8. ■

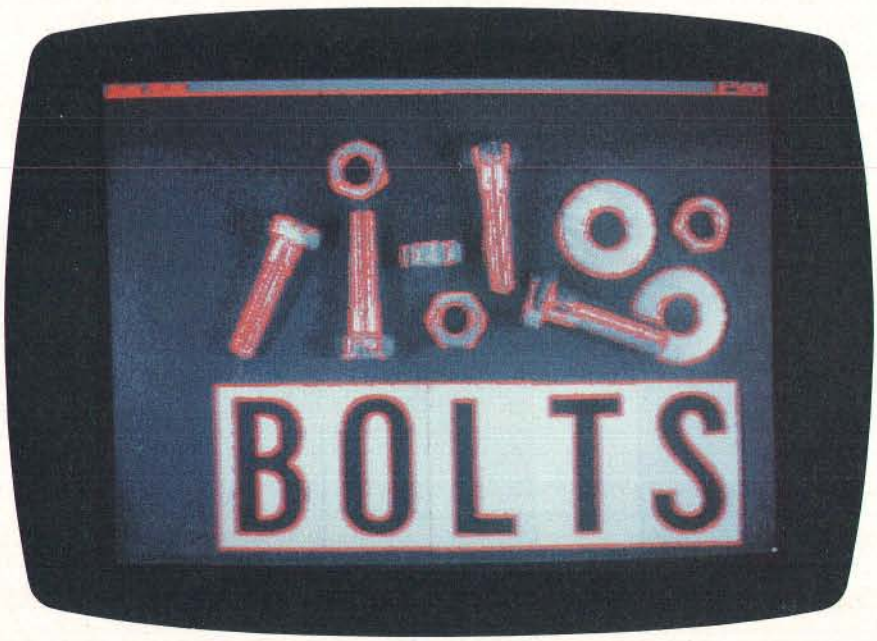


Photo 3: *The image of photo 1, edge-detected by the image processing program described in the text, with the threshold set to 4.*

What a Fabulous Deal!
Celebrate our 3 Years Anniversary
QIC-286-10A

(10 MHz) **$799** Basic Unit



Made in USA

With Option $1125

- **Fully IBM AT™ Compatible**
- **80286 CPU, 10/8 MHz**
- **Six 16-bit and two 8-bit expansion slots**
- **Clock/Calendar with AA battery backup**
- **195 W Power supply,**
- **Complete 200 page easy to follow manual**
- **FCC Class'B' approved**
- **One year warranty**

Standard Maxi-switch Keyboard

Option: 1.2MB or 360K Floppy Disk Drive
Combined Floppy/Hard Disk controller

ENHANCEMENT PRODUCTS FOR AT

Hard Disk	• Seagate 20MB Half-Height Hard Disk (w/controller)	$359
	• Seagate 30MB Full-Height Hard Disk—High speed	$628
	• Seagate 40MB Half-Height Hard disk	$699
Graphic Card	• Enhanced Graphic Card with 256K RAM	$215
	• QIC Monographics card (Hercules Comp.)	$95
Tape Backup	• 60MB Cartridge Tape Back Up (Internal)	$794
	• 20MB Cassette Tape Back Up (Internal)	$599
Modem	• Everex 300/1200 Half-Size Modem Card	$128
	• Everex 1200/2400, Half-Size Modem Card	$239
Multi function Card	• AT Multi-function Card 0K (to 1.5MB)	$179
	• QIC Ram 3000, 0K (expandable to 3MB)	$155
	• **QIC Turbo XT w/640K, 1 Floppy Drive**	**$479**

QIC RESEARCH INCORPORATED
753 Ames Avenue
Milpitas, CA 95035

(408) 942-8086 (Sales)

Dealer/Corporate Inquiries Welcome. University P.O.'s are Welcome
FAX No. 408-263-1447 (Tech Support) (408) 942-0856

Inquiry 241

PreScript

A proposed standard would streamline the process of capturing and manipulating image data

Ken Sheldon

DESKTOP PUBLISHING, the ability to produce high-quality publications using a microcomputer, essentially boils down to combining words and images on pages. Every desktop publishing software package deals with these two types of information in its own way, and each provides different features and capacities.

Typically, you incorporate text into a desktop publishing program by entering it directly from the keyboard or importing a standard ASCII text file created by a word processor. The method of importing *images,* however, varies widely from package to package and computer to computer.

True desktop publishing programs let you import an image file into your document, and the format of these image files varies widely depending on the package and your computer. Other packages allow you to scan an image (using, for example, a camera or page scanner) from within the application and place the image directly into the document on which you are working.

Camera and scanning devices usually perform some low-level image processing, such as improving the contrast, to make the images more presentable. Some desktop publishing packages allow you to enhance the images further after capturing them; other packages force you to scan the image and "take it or leave it." You can, of course, attack an image file at the bit-map level and perform your own image processing to enhance it before importing it into your desktop publishing program, though this will be beyond the interest and abilities of many users.

Enter PreScript

In the face of this conglomeration of features and capabilities, Datacopy Corporation has proposed a standardized high-level language for importing image data into desktop publishing and other application programs. The proposed standard, called PreScript, consists of three parts: high-level language calls that reside in the application program; an interpreter that translates the commands for a particular image processing system; and an intelligent image processing system that controls the scanning process and contains its own microprocessor that handles the algorithms for image processing.

PreScript, which is invisible to the user of an application, sends commands to the PreScript interpreter through an SCSI port. The interpreter passes the commands, translated for a particular image processing system, to a signal processing router/scheduler (SPRS) in the form of an image description table. This table dictates the specific image processing functions and the order in which they are to be performed on the image data.

The SPRS manages the flow of image data between the various image processing algorithms and also interfaces with the controller of the camera or scanner. A microprocessor performs the actual image processing operations, with the help of optional coprocessors (e.g., pipeline processors, which are ideal at performing the many repetitive operations required to enhance image data). Depending on the manufacturer, the "intelligence" for the image processing functions may reside within the scanning device, in a chassis that sits between the scanner and the host microcomputer, or on an expansion board in the computer.

The PreScript standard currently describes a list of commands and image processing algorithms that are to be built into such PreScript-capable systems (see table 1). In addition, application programmers can develop new algorithms that may be downloaded to the intelligent scanner and called via PreScript.

Figure 1 shows a typical image-capture problem: The scan area contains two types of images, a continuous-tone photograph (window 1) and a line drawing that overlaps the photograph (window 2). Suppose you want to double the size of the photograph, halftone the photograph, reduce the line drawing to one-half its size, enhance the line edges to reduce breaks caused by the scanning and reduction process, and then perform a thresholding operation that "binarizes" the entire image (converts all pixels into either black or white).

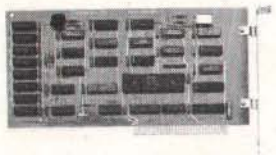
For the application programmer to provide you with this capability could take from several hundred to several thousand lines of code. With a PreScript intelligent system, however, the programmer would need only include the

continued

Ken Sheldon is a technical editor for BYTE. He can be reached at BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

CP/M Emulation on PC

Run CP/M software with our Z80 and HD64180 coprocessor cards. Superspeed version runs at an incredible 12.5 mhz. No wait states! Blue Thunder 6 mhz coprocessor $249.95. ZSIM Software/V20 emulator $99.95.



BLUE THUNDER

DEVELOPERS!

Our **Z80** and **HD64180** plug-in PC co-processors give you the hardware and software basis for the best Z80 family development systems. For example, you can run the *SLR Systems Superfast* assembler, which runs 10-20 times faster than Avocet or 2500AD cross assemblers. Our DSD80 *remote* debugger eliminates the need for an in-circuit emulator.

RUN ISIS *Very Fast*

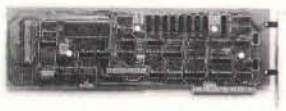
Plug in one of our co-processors, running at a clock speed up to 12.5 mhz. Then run your Intel development tools on your PC as much as 20 times faster. Runs ASM51, ASM80, CREDIT, etc. $395.00 and up.

HD64180 SHORT CARD

Our newest co-processor has 2 serial ports and runs at 6.144 mhz. $295.00. 9.216 mhz available.

HD64180 PC Satellite Real Time Coprocessor

Our D64180 coprocessor has Hitachi's newest Z80 compatible microprocessor. You get serial ports, counter timers, DMA and a well-documented interface to your PC. *This unit accepts Intel standard iSBX bus piggyback boards.* You can add any of over 100 peripheral cards from dozens of manufacturers. Use it to unload real time control or communications from the host PC. Also serves as an HD64180 development system.



D64180 Co-processor

We cater to professional software developers. Examine our quality and performance.

Z-World
2065 Martin Ave. #110
Santa Clara, CA 95050
(408) 980-1678

Table 1: *The entire PreScript built-in vocabulary, which includes both symbols and words. Most commands are highly descriptive of the functions they perform.*

{..any letter..}
{..any digit..}
%
$
( )
[ ]
#nn
Add
Archive
Archive_Reset
Archive_Restore
Area_Compensation
Compression
Convolution
Def
Device_Frame_Get
Device_Frame
Device_Select
Div
Dup
Edge_Mask
Error_Diffusion
Gamma_Correction
Halftone
Inch
Invert
Mask
Mirror
Mul
Roll
Scaling
Scan
Sub
Swap
Synonym
Threshold
Window_Frame
Window_Select

following PreScript commands in the application:

```
1 Device_Select
1 Window_Select
10 10 200 200 Window_Frame
2 2 Scaling
Mask Halftone
2 Window_Select
40 40 300 300 Window_Frame
0.5 0.5 Scaling
Edge_Mask Convolution
128 Threshold
Scan
```

These commands select the scanning device, the windows (their size and location), and the scaling (enlargement or reduction) for each window. They also determine the image processing algorithms to be performed on each window and instruct the device to begin the scan.

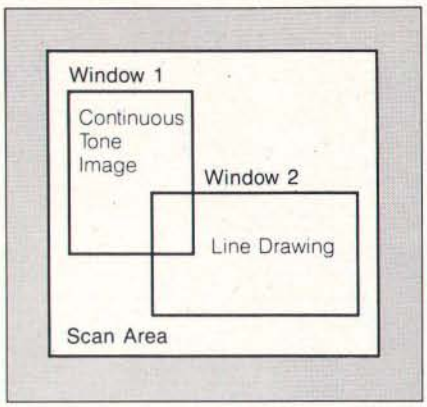


Figure 1: *A typical image-capture problem that might be addressed by PreScript.*

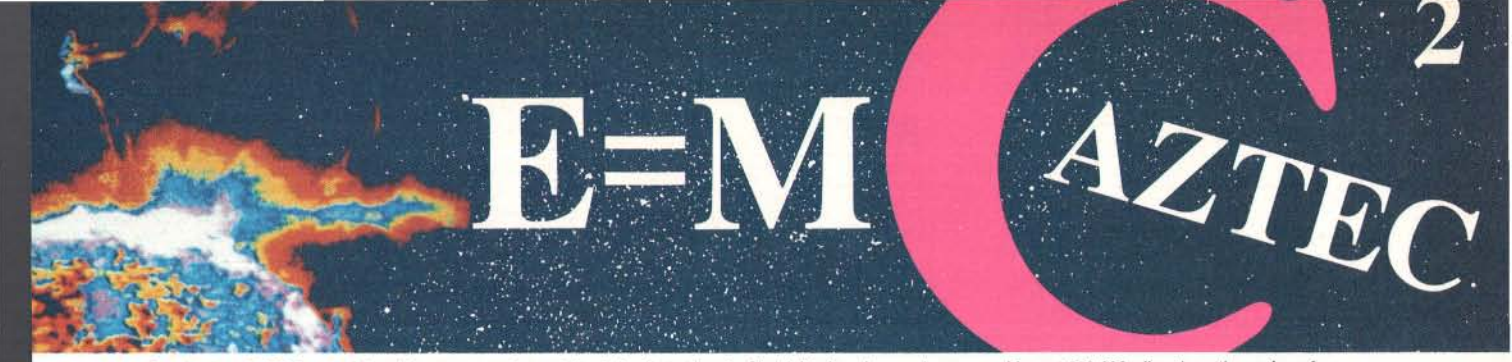
After the image processing system performs the desired operations on the image data, it sends the data back to the application program through the SCSI port. Although PreScript does not specify the file format into which the image data is placed, Datacopy's application software will support the Tag Image File Format (TIFF) now used by Aldus, Microsoft, and other software publishers. Use of the TIFF standard by software publishers will allow, for example, an image captured with an IBM PC-based system to be transferred to a Macintosh, where it can be incorporated into desktop publishing programs that also support TIFF, and vice versa.

Standard Advantages

Using PreScript would allow application developers to incorporate image enhancement technology into their programs without having to develop from scratch the algorithms to work with a variety of scanning devices and computers. Programmers will simply tell the scanner/image processing firmware what to do, not how to do it. In this regard, PreScript is nonprocedural, as opposed to a procedural page-description language such as PostScript.

The widespread acceptance of PreScript by the makers of scanning devices and application programs would mean that you could use your application programs with a variety of scanning devices. You would have more control over the way image data appears in newsletters, reports, and other publications.

PreScript is available for licensing from Datacopy Corporation to OEMs and developers of desktop publishing and other application programs. ■



Our thanks to NASA for supplying this computer enhanced ultraviolet photo taken by Skylab IV of a solar prominence reaching out 350,000 miles above the sun's surface

Genius Begins With A Great Idea ...

But The Idea Is Just The Beginning

What follows is the time consuming task of giving form and function to the idea.

That's why we concentrate on building into our software development systems functions and features that help you develop your software ideas in less time and with less effort.

We've started 1987 by releasing new versions of our MS-DOS, Macintosh, Amiga, ROM, and Apple // C development systems. Each system is packed with new features, impressive performance, and a little bit more genius.

Aztec C86 4.1

New PC/MS-DOS • CP/M-86 • ROM

Superior performance, a powerful new array of features and utilities, and pricing that is unmatched make the new Aztec C86 the first choice of serious software developers.

Aztec C86-p Professional System $199
• optimized C with near, far, huge, small, and large memory + Inline assembler + Inline 8087/80287 + ANSI support + Fast Float (32 bit) + optimization options • Manx Aztec 8086/80x86 macro assembler • Aztec overlay linker (large/small model) • source level debugger • object librarian • 3.x file sharing & locking • comprehensive libraries of UNIX, DOS, Screen, Graphics, and special run time routines.

Aztec C86-d Developer System $299
• includes all of Aztec C86-p • Unix utilities make, diff, grep • vi editor • 6+ memory models • Profiler.

Aztec C86-c Commercial System. $499
• includes all of Aztec C86-d • Source for library routines • ROM Support • CP/M-86 support • One year of updates.

Aztec C86 Third Party Software

A large array of support software is available for Aztec C86. Call or write for information. The following is a list of the most requested products: Essential Graphics • C Essentials • C Utility Library • Greenleaf Com. • Greenleaf General • Halo • Panel • PC-lint • PforCe • Pre-C • Windows for C • Windows for Data C terp • db Vista • Phact • Plink86Plus • C-tree.

CP/M • TRS-80 • 8080/Z80 ROM

C compiler, 8080/Z80 assembler, linker, librarian, UNIX libraries, and specialized utilities.

Aztec C II-c (CP/M-80 & ROM). $349
Aztec CII-d (CP/M-80) $199
Aztec C80 (TRS-80 3&4) $199

Aztec C68k/Am 3.4

New Amiga Release

Amiga user groups across the USA voted Aztec C68k/Am release 3.3 the best Software Development System for the Amiga. Release 3.4 is more impressive.

Aztec C68k/Am-p Professional $199
A price/feature/performance miracle. System includes: optimized C • 68000/680x0 assembler • 68881 support • overlay linker • UNIX and Amiga libraries • examples.

Aztec C68k/Am-d Developer $299
The best of Manx, Amiga, and UNIX. System includes: all of Aztec C68k/Am-p • the Unix utilities make, diff, grep and vi.

Aztec C68k/Am-c Commercial $499
Aztec C68k/Am-d plus source for the libraries and one year of updates.

Aztec C68k/Mac 3.4

New Macintosh Release

For code quality, reliability, and solid professional features, Aztec C for the Macintosh is unbeatable. This new release includes features and functions not found in any other Macintosh C development system.

Aztec C68k/Mac-p Professional $199
• optimized C • 68000/680x0 assembler • 68881 support • overlay linker • UNIX and Macintosh libraries • examples.

Aztec C68k/Mac-d Developer. $299
The best of Manx, Macintosh, and UNIX. System includes: all of Aztec C68k/Am-p • the Unix utilities make, diff, grep • vi editor.

Aztec C68k/Mac-c Commercial $499
Aztec C68k/Am-d plus source for the libraries and one year of updates.

Aztec C65

New ProDOS Release

Aztec C65 is the only commercial quality C compiler for the Apple II. Aztec C65 includes C compiler, 6502/65C02 assembler, linker, library utility, UNIX libraries, special purpose libraries, shell development environment, and more. An impressive system.

Aztec C65-c Commercial $299
• runs under ProDOS • code for ProDOS or DOS 3.3

Aztec C65-d Developer. $199
• runs under DOS 3.3 • code for DOS 3.3

Aztec ROM Systems

6502/65C02 • 8080/Z80 • 8086/80x86 • 680x0

An IBM or Macintosh is not only a less expensive way to develop ROM code, it's better. Targets include the 6502/65C02, 8080/Z80, 8086/80x86, and 680x0.

Aztec C has an excellent reputation for producing compact high performance code. Our systems for under $1,000 outperform systems priced at over $10,000.

Initial Host Plus Target $750
Additional Targets $500
ROM Support Package $500

Vax, Sun, PDP-11 ROM HOSTS

Call for information on Vax, PDP-11, Sun and other host environments.

C' Prime

PC/MS-DOS • Macintosh
Apple II • TRS-80 • CP/M

These C development systems are unbeatable for the price. They are earlier versions of Aztec C that originally sold for as much as $500. Each system includes C compiler, assembler, linker, librarian, UNIX routines, and more. Special discounts are available for use as course material.

C' Prime $75

Aztec Cross Development Systems

Most Aztec C systems are available as cross development systems. Hosts include: PC/MS-DOS, Macintosh, CP/M, Vax, PDP-11, Sun, and others. Call for information and pricing.

How To Become An Aztec C User

To become a user call 800-221-0440. From NJ or international locations call 201-542-2121. Telex: 4995812 or FAX: 201-542-8386. C.O.D., VISA, MasterCard, American Express, wire (domestic and international), and terms are available. One and two day delivery available for all domestic and most international destinations.

Aztec C is available directly from Manx and from technically oriented computer and software stores. Aztec Systems bought directly from Manx have a 30 day satisfaction guarantee.

Most systems are upgradable by paying the difference in price plus $10. Site licenses, OEM, educational, and multiple copy discounts are available.

MANX

Inquiry 178

Manx Software Systems
1 Industrial Way, Eatontown, NJ 07724

To order or for more information call today.

1-800-221-0440

In NJ or international call (201) 542-2121 • TELEX: 4995812

MS is a registered TM of Microsoft, Inc., CP/M TM DRI, HALO TM Media Cybernetics, PANEL TM Roundhill Computer Systems, Ltd., PHACT TM PHACT Assoc., PRE-C, Plink-86, Plink-86 +, P-Force TM Phoenix, db Vista TM Raima Corp., C-terp, PC-lint, TM Gimpel Software, C-tree TM Faircom, Inc., Windows for C, Windows for DATA TM Creative Solutions, Apple II, Macintosh TM Apple, Inc., TRS-80 TM Radio Shack, Amiga TM Commodore Int'l., Unix TM AT&T, Vax TM DEC, Aztec TM Manx Software Systems

The fastest C

Your search for execution speed is over. The new Microsoft® C Compiler Version 4.0 is here. With blazing performance. We've added common sub-expression elimination to our optimizer that produces code that rips through the benchmarks faster than ever before.

"...the Microsoft performance in the benchmarks for program execution is the best of the lot overall." —William Hunt, *PC Tech Journal*, January, 1986.*

But speed isn't the only edge you get with Microsoft C. Other advantages include a variety of memory models like our new HUGE model that breaks the 64K limit on single data items. Plus our NEAR, FAR and HUGE pointers, which provide you greater flexibility. All this allows you to fine tune your program to be as small and fast as possible.

"Excellent execution times, the fastest register sieve, and the best documentation in this review ...Microsoft Corporation has produced a tremendously useful compiler." —Christopher Skelly, *Computer Language*, February, 1986.

No more debugging hassles. Introducing CodeView. Free.

Now, for a limited time, we'll give you an unprecedented programming tool when you buy Microsoft C, free. New Microsoft CodeView™ offers the most powerful tool yet in the war on C bugs. Forget the hex dumps. Now you can view and work with programs at any level you want. Use the program source, the disassembled object code, or



Microsoft C Compiler Version 4.00

Microsoft C Compiler

- Produces fast executables and optimized code including elimination of common sub-expressions. NEW!
- Implements register variables.
- Small, Medium and Large Memory model libraries.
- Compact and HUGE memory model libraries. NEW!
- Can mix models with NEAR, FAR and the new HUGE pointers.
- Transport source and object code between MS-DOS® and XENIX® operating systems.
- Library routines implement most of UNIX™ System V C library.
- Start-up source code to help create ROMable code. NEW!
- Full proposed ANSI C library support (except clock). NEW!
- Large number of third party support libraries available.
- Choose from three math libraries and generate in-line 8087/80287 instructions or floating point calls:
  - floating point emulator (utilizes 8087/80287 if installed).
  - 8087/80287 coprocessor support.
  - alternate math package – extra speed without an 8087/80287.
- Link your C routines with Microsoft FORTRAN (version 3.3 or higher), Microsoft Pascal (version 3.3 or higher) or Microsoft Macro Assembler.
- Microsoft Windows support and MS-DOS 3.1 networking support.
- Supports MS-DOS pathnames and input/output redirection.

Microsoft Program Maintenance Utility. NEW!

- Rebuilds your applications after your source files have changed.
- Supports macro definitions and inference rules.

Other Utilities

- Library Manager.
- Object Code Linker.
- EXE File Compression Utility.
- EXE File Header Utility.

C Benchmarks In seconds

	Microsoft C 4.0	Lattice C 3.0	Computer Innovation C 2.3	Aztec C86 3.2	Wizard C 3.0
Sieve of Eratosthenes (register)	82.9	151.4	172.3	88.0	91.9
Copy Block	86.9	231.7	199.0	123.8	189.5

Run on an IBM PC XT with 512K memory

Microsoft CodeView
Window-oriented source-level debugger. NEW!

- Watch the values of your local and global variables and expressions as you debug.
- Set conditional breakpoints on variables, expressions or memory; trace and single step.
- Watch CPU registers and flags as you execute.
- Effectively uses up to four windows.
- Debug using your original source code, the resulting disassembly or both intermingled.
- Use drop-down menus to execute CodeView commands.
- Access the on-line help to lead you through CodeView's options and settings.
- Easily debug graphics-oriented programs since program output is kept separate from debugger output.
- Keyboard or optional mouse support.
- Enter in familiar SYMDEB or DEBUG commands.

*Reprinted from *PC Tech Journal*, January 1986, copyright 1986, Ziff-Davis Publishing.

you've ever seen.

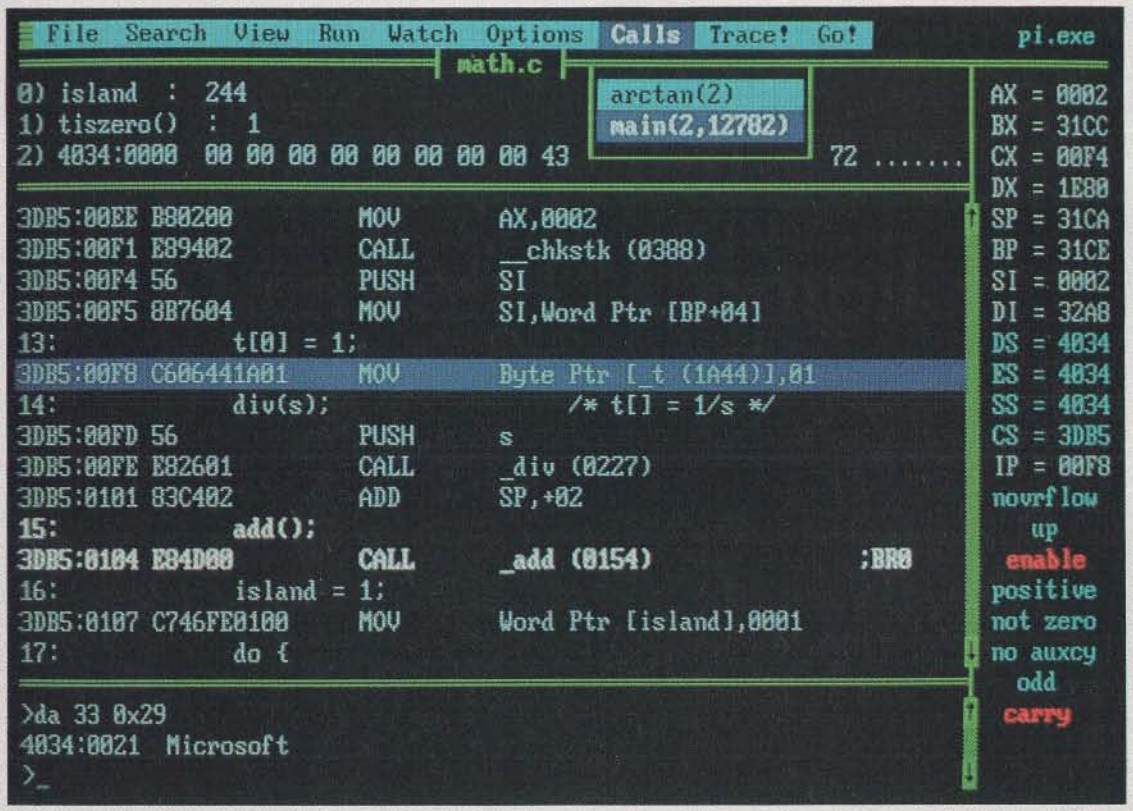
both at the same time. Open a window to view CPU registers and flags. Watch local and global variables as well. All while your program is running.

CodeView gives you complete control. Trace execution a line at a time—using source or assembly code. Or set conditional breakpoints on variables, memory or expressions. CodeView supports the familiar SYMDEB command syntax, as you'd expect. Commands are also available through drop-down menus. Combine the new window-oriented interface with our on-line help and debugging has never been easier. Or quicker.

Take the $5 CodeView tour.

You may find it hard to believe our debugger can do all we've claimed. So we're offering test drives. Five bucks will put you behind the wheel of a Microsoft C demo disk with CodeView.† See for yourself how fast debugging can get.

For more information about the CodeView demo disk, the new Microsoft C Compiler, a list of third party library support or the name of your nearest Microsoft dealer, call (800) 426-9400. In Washington State and Alaska, (206) 882-8088. In Canada call (416) 673-7638.



Microsoft® C Compiler

The High Performance Software

Microsoft, MS-DOS and XENIX are registered trademarks and CodeView is a trademark of Microsoft Corporation. UNIX is a trademark of AT&T Bell Laboratories. IBM is a registered trademark of International Business Machines Corporation. †Offer expires 12/31/86.

Finally, a language worth

For years BASIC has been everyone's first language. And for almost as long, they've been tempted by other languages. Lured by promises of more speed, more power.

We have a solution. A new language that's a substantial improvement over BASICA. Faster. More structured. Finally, a compelling reason to leave BASIC.

Introducing Microsoft's QuickBASIC Compiler, Version 2.0.

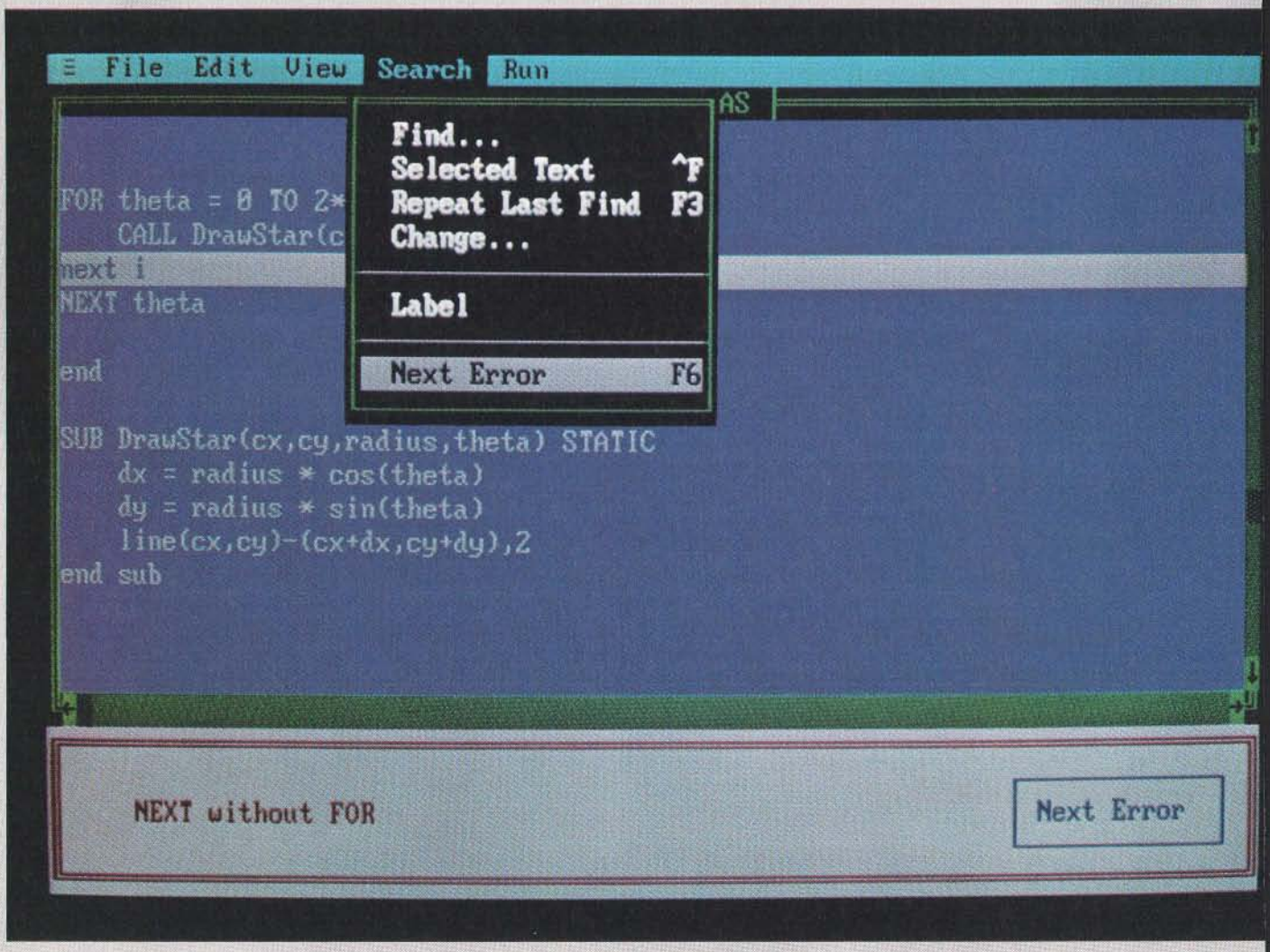
At last, you can have the latest programming techniques, combined with the solid foundation of BASIC. Our new compiler is as compatible with BASICA as you can get. At the same time it offers the extra speed and power you've been looking for.

Run faster with compiled code.

If there's one thing you've asked for, it's speed. And Microsoft® QuickBASIC simply blazes. Old BASICA programs will run up to ten times quicker once they've been compiled. Sometimes even faster.

Everything you need. Built-in.

Making programs run faster is only part of the story, though. The new Microsoft QuickBASIC Compiler includes a full-screen editor, built-in. So now you can make the jump from writing to RUNning in no time flat. Edit your program, compile it, and run it. Faster than any other BASIC compiler around. All without leaving our on-line help and prompts.



Microsoft is a registered trademark and The High Performance Software is a trademark of Microsoft Corporation. IBM is a registered trademark of International Business Machines Corporation.

leaving BASIC for.

On the rare chance your program doesn't run 100% the first time out, we've got another surprise for you. The Microsoft QuickBASIC debugger. Our full-screen tracing lets you debug your programs while watching the source code execute. A line at a time, or with breakpoints. As easy as can be.

Our compiler is also smart enough to save you time. First, by finding any errors in one pass. Second, by putting your editor's cursor on the problem. Automatically. So you don't have to get lost in a maze of error codes and line-numbers.

The BASIC virtues. And more.

Speaking of line numbers, let's not. Because line numbers are strictly optional. And Microsoft QuickBASIC lets you use alphanumeric labels as well. Now you can GOTO *ErrorCheck* instead of line number 6815.

Or you could stop using GOTOs altogether. There are a variety of options that could make the GOTO an endangered species. Features like multi-line IF-THEN blocks. And named subprograms. Now your BASIC programs can be as structured and organized as you want.

We've only just begun to talk about the virtues of Microsoft QuickBASIC. There are dozens of enhancements to your favorite language. Things like larger arrays. Local and global variables. Reusable modules that let you create libraries of your most often-used routines. All explained in a revised manual that includes a complete language reference.

Making your quick escape.

If all these features follow your BASIC instincts, then zip on down to your nearest Microsoft dealer. That's where you'll discover the best surprise of all. The price. Only $99 for the best reason to leave BASIC.

For the name of your nearest Microsoft dealer, call (800) 426-9400. In Washington State and Alaska, (206) 882-8088. In Canada, call (416) 673-7638.

Microsoft® QuickBASIC
The High Performance Software™

Microsoft QuickBASIC Compiler Version 2.0 for IBM® PC and Compatible Computers.

BASICA Compatibility
- Sound statements including SOUND and PLAY.
- Graphics statements including WINDOW, VIEW, DRAW, GET, PUT, LINE, CIRCLE, LOCATE and SCREEN.
- Support of EGA extended graphics modes. NEW!
- BASICA structures are supported including WHILE/WEND, IF/THEN/ELSE, FOR/NEXT, GOSUB/RETURN, and event handling.

Results of Sieve Benchmark	BASICA 3.1	Microsoft QuickBASIC 2.0
Seconds per iteration	78	0.52

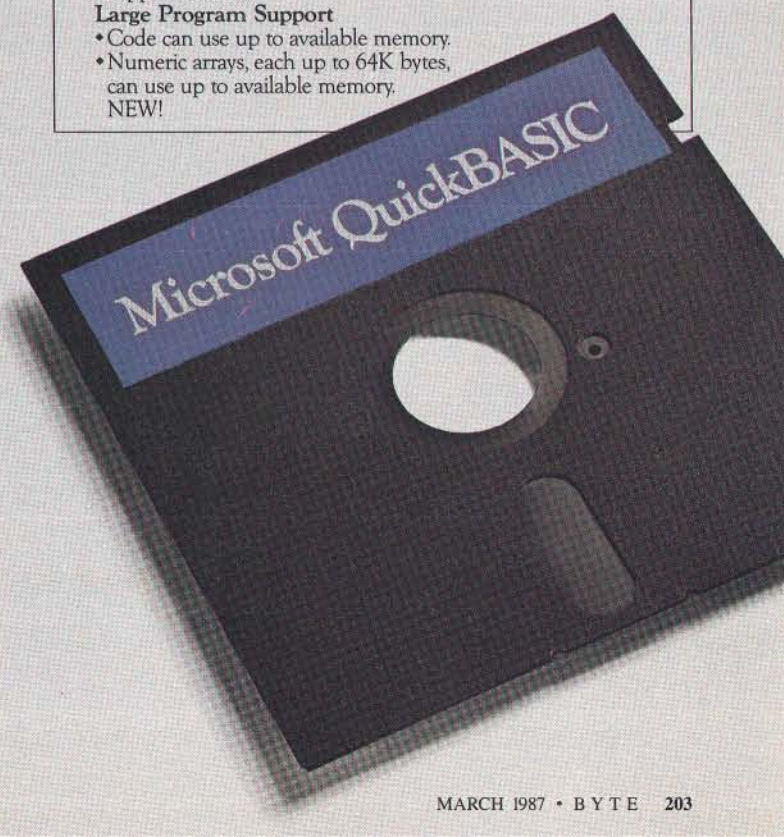
Complete Programming Environment
- Built-in Editor that places the cursor on found errors automatically. NEW!
- Compile entirely in memory at speeds up to 6000 lines per minute. NEW!
- Link routines once when starting a programming session and no need to link again when changing programs. NEW!
- Built-in debugger with single-step, animate, and trace modes. NEW!
- Create stand-alone programs.

Alphanumeric Labels
- Can be used to make your programs more readable. Line numbers are not required but are supported for BASICA compatibility.

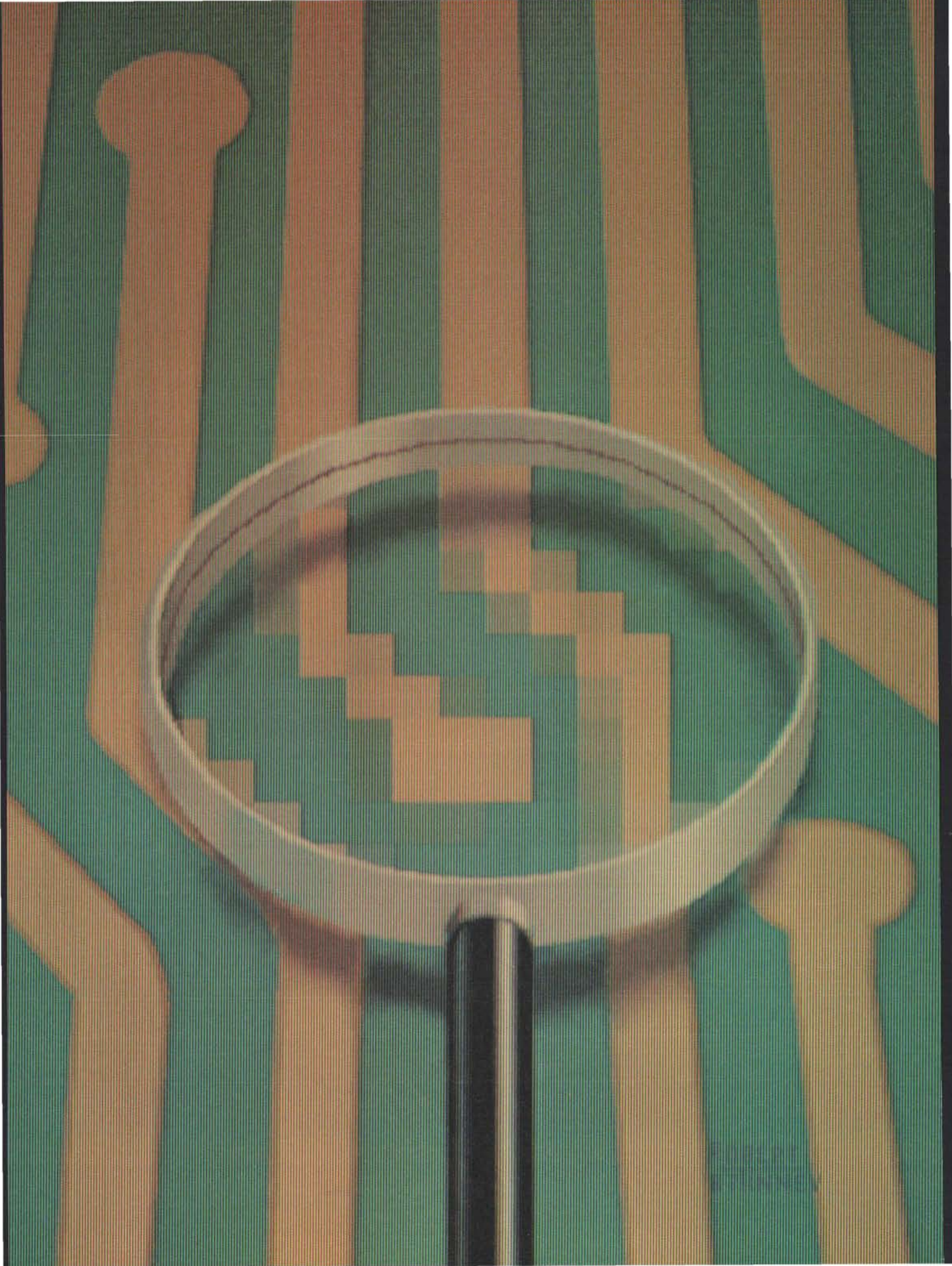
Structured Programming Support
- Block IF/THEN/ELSE/END IF eliminates the need for GOTO statements. NEW!
- Subprograms can be called by name and passed parameters. Both local and global variables are supported.

Modular Programming Support
- Separate compilation allows you to create compiled BASIC libraries to use and re-use your programs.
- A library of routines to access DOS and BIOS interrupts is supplied. NEW!

Large Program Support
- Code can use up to available memory.
- Numeric arrays, each up to 64K bytes, can use up to available memory. NEW!



Inquiry 366



Reviews

Reviewer's Notebook
by Cathryn Baskin 207

A Trio of 8-MHz PC AT Compatibles
by Stan Miastkowski 209

AT&T's TrueVision Image Processing System
by Robert Tinney 215

Four Laser Printers
by Arthur Little 217

PC Scheme: A Lexical LISP
by William G. Wong 223

Concurrent PC DOS
by Wayne Rash Jr. 226

Wendin's Operating System Toolbox
by Jason Levitt 228

PFS:First Choice
by Larry D. Allen 235

WriteNow for the Macintosh
by Mick O'Neil 237

CAD-3D
by Rusel DeMaria 238

Review Feedback 244

BASED ON PERFORMANCE ALONE, it's often difficult to distinguish one IBM PC AT compatible from another. Stan Miastkowski finds that the three 8-MHz systems reviewed this month—the NCR PC8, the Victor V286, and the QIC AT-Plus 1800—are set apart by other factors. Each comes equipped with different options and software, and their prices vary considerably.

To complement our image processing theme, BYTE illustrator Robert Tinney reviews AT&T's TrueVision video image processing system. For Robert's work as a print illustrator, the system proved to be an invaluable tool for sketching, though less satisfactory for finished artwork.

Laser printers are as common as PC AT clones these days, and reviewer Arthur Little evaluates four models: the Canon LBP-8, the BDS Model 630/8-E, the QMS Kiss, and the Quadram QuadLaser. The QMS Kiss stands out as the best value, while the others offer distinctive features that make them more appropriate for specific applications.

Our language reviews this month start off with PC Scheme, a PC-based implementation of the Scheme dialect of LISP. Reviewer William G. Wong finds the program useful for some symbolic and graphics applications. With a few enhancements, William says, the package could serve well as a general-purpose language.

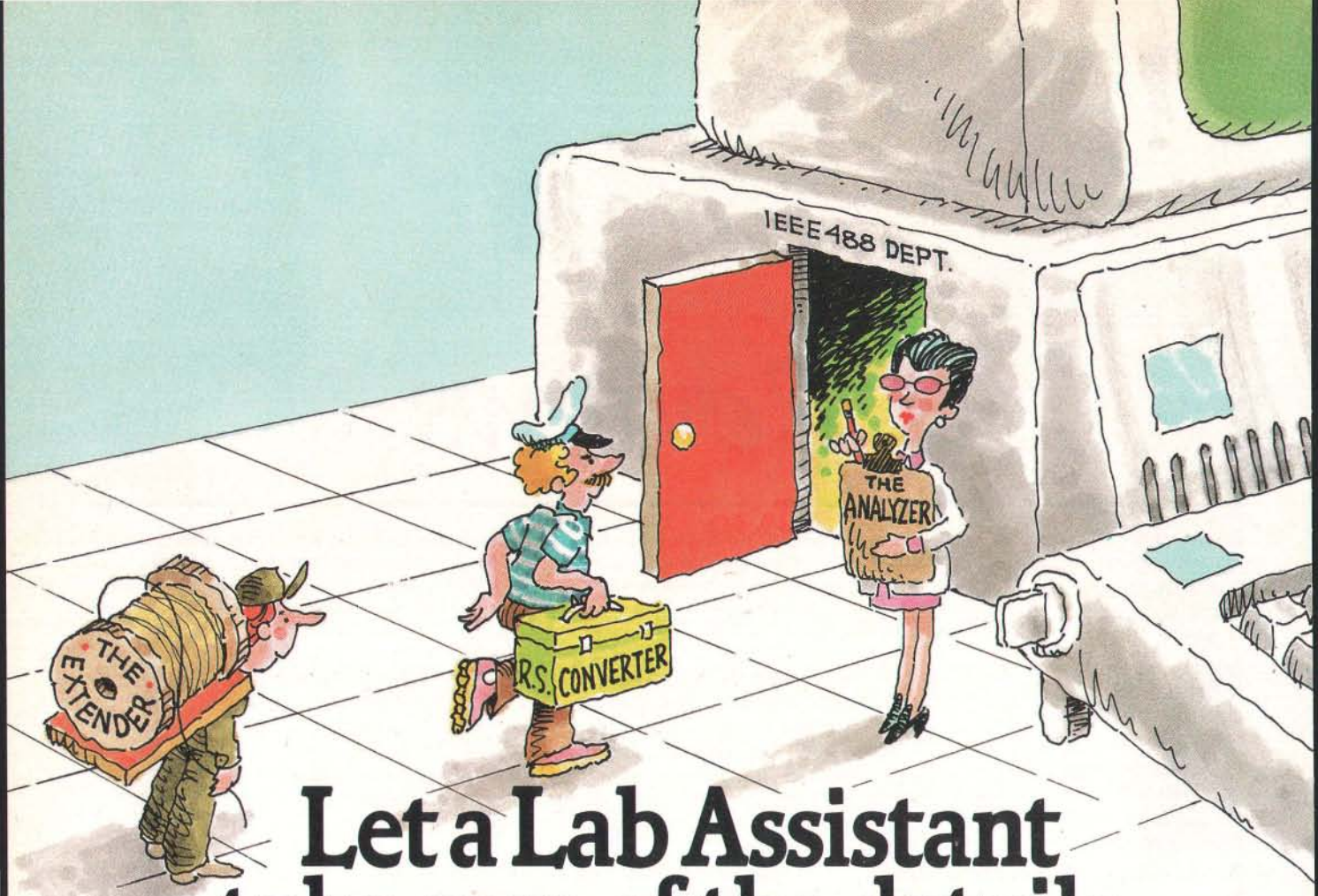
Also written for MS-DOS–based systems is Concurrent PC DOS, Digital Research's multiuser multitasking operating system. The system requires more skill to use and set up than a single-user system, according to reviewer Wayne Rash Jr., but it's an inexpensive way to get multitasking capabilities.

The ability to create personalized operating systems is provided by Wendin's Operating System Toolbox, which offers about 300 files with C source code and assembly code. Jason Levitt strongly recommends the OST as an educational tool and for creating a user interface. The package's problems, he maintains, are not its fault but those of MS-DOS and the 8088.

In application reviews this month, Larry D. Allen examines Software Publishing's PFS:First Choice, an integrated package for IBM PC compatibles that offers word processing, spreadsheet, file-management, and telecommunications capabilities. Designed for first-time computer users, Larry finds that the $149 package can be quickly learned but might also be easily outgrown.

WriteNow for the Macintosh, a word processor from T/Maker, impressed reviewer Mick O'Neil with its outstanding performance and a variety of advanced features. Only a few missing features—there's no glossary, for instance—keep Mick from pronouncing it the complete word processor for the Macintosh.

For the Atari ST, Rusel DeMaria looks at CAD-3D, a three-dimensional modeling package. A bargain at $49.95, the package lets you manipulate three-dimensional objects in up to four simultaneous views and offers superb, though slow, animation. Because it lacks a few features like autodimensioning and labeling, Rusel concludes that it's more appropriate for design and animation than for drafting.



Let a Lab Assistant take care of the details.

Powerful accessories for IEEE-488 and RS-232/422 instrument controllers.

The Extender: More devices, greater range.



Now you can really stretch your lab's IEEE-488 network to its full potential. With a National Instruments Bus Extender you can connect up to 28 devices to your IEEE-488 port, and connect to instruments as far away as 2,000 meters. There's no loss of transmission quality, and there's no need to change your application program. The extender is compatible with our full line of IEEE-488 interfaces, and can incorporate either fiber optic, coax, or parallel cabling.

RS Converter: Docks at any serial port.

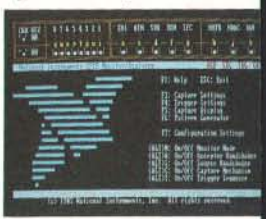
Our RS Converter bridges the electronic gap between RS-232/422 and IEEE-488. You can use it to control your lab's GPIB network via your computer's RS-232/422 port. Or to control RS-232/422 devices via an IEEE-488 bus.



Each Bus Converter comes with two full duplex serial ports and a 2K to 32K byte data buffer for maximum throughput. All switches and connections are external—you never have to open the unit. Just hook-up the appropriate devices and the system is ready.

The Analyzer: Glitch patrol for your PC.

Our most intelligent lab assistant is the National Instruments Bus Analyzer/Monitor, which lets you perform high-level bus monitoring and analysis on any IBM-PC or compatible. It can store data in memory for later analysis. Or provide real-time information for early warning of system glitches. You can also use our Bus Analyzer/Monitor to run user-defined files in order to prototype and debug GPIB systems. It comes as a single plug-in circuit card, and allows the PC to maintain all its standard functioning.



NATIONAL INSTRUMENTS
12109 Technology Blvd.
Austin, TX 78727
1-800/531-4742 512/250-9119

Inquiry 202

REVIEWER'S NOTEBOOK

Always lively, BYTE's review department has been more hectic than usual lately. Part of the commotion results from recent staff changes, but a large part comes from new projects, changes in review procedures, and what seems like a growing barrage of new products.

Most of the changes we're undertaking are aimed at continuing to evaluate as many of these products as possible without skimping on technical depth and at making these reviews more timely—a bear of a problem for a monthly publication with long lead times. To attack both these problems, we will be making more use of BIX, a strategy that former review editor Jon Edwards began almost a year ago.

Until now, the byte.reviews conference on BIX has been used chiefly to publish reviews that we've been unable to include in the magazine because of limited space. Now that conference will hold all reviews, both published and unpublished, beginning with reviews appearing in the January 1987 issue. We will also continue to post reviews that we simply can't squeeze into the magazine. In some instances, charts and tables that appear on BIX may not be formatted as they are in the magazine. But the information on BIX will be as complete as that in the magazine, and we think that the early chance to read reviews will more than justify any inconvenience.

Since limited space in the magazine often curtails the number of letters we can publish here, we encourage you to post your reactions to these products and reviews in the byte.reviews conference. In some instances, we'll be able to incorporate this additional feedback into the magazine, giving our non-BIX-subscribing readers the benefit of information from users other than the reviewer who may have valuable feedback on a product.

We will also use BIX to post information on product reviews that we've scheduled for future issues. Again, your comments on these upcoming reviews are welcome, as are suggestions for future reviews; watch BIX and these pages for further information.

Over the past several months, with the introduction of faster machines and peripherals, as well as add-ins and software that take advantage of that speed, we've

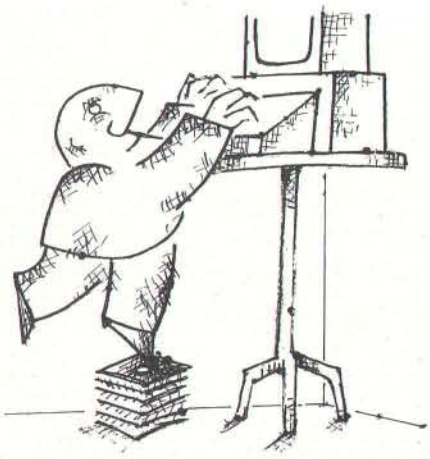


ILLUSTRATION BY MACIEK ALBRECHT

also become aware that BYTE's venerable benchmarks demand revision to accommodate developments in technology. Dennis Allen, technical editor in charge of review standards, has taken on the job of evaluating BYTE's existing benchmarks and updating them as necessary. Dennis will also be establishing our benchmarks in new areas such as graphics. To aid this process, he has started another BIX conference, called benchmarks, to examine the goals and philosophy of benchmarks and discuss specific tests for systems, peripherals, languages, applications, and utilities. The conference is open to all, and your participation is encouraged.

To further upgrade the quality of our reviews, Dennis is also coordinating a telephone survey of a randomly selected group of BYTE subscribers. We'll query you about your satisfaction with current reviews and ask about changes you'd like to see. If you're not among the chosen, feel free to drop us a note in the mail.

All this, we think, will ensure the most thorough, accurate, and timely coverage of new products that BYTE can provide. And our product reviews will begin bearing the fruit of this effort immediately. For instance, a comprehensive roundup of 9-, 18-, and 24-pin dot-matrix printers will incorporate BYTE's new printer benchmarks. In addition to testing throughput and bit-mapped graphics capabilities, the benchmarks will be accompanied by tests for sound levels, alignment, and other features. Technical editor George Stewart has been wrestling with these printers for weeks, and we'll bring you his results next month.

In another issue this spring, Stephen Satchell will follow up his December 1986 review of external modems with a review of high-speed internal modems. Responding to reader feedback, Stephen has refined his tests, and we look forward to seeing his results. We're also beginning a series of reviews of 80286-based machines faster than the hordes of 6- and 8-MHz IBM PC AT compatibles, many of which we've already reviewed. Look for evaluations of systems that purport to run at 10, 12, and 16 MHz and offer other features that distinguish them from the rest of the clones.

Calls to companies during the weeks following November's COMDEX have yielded little in the way of getting our hands on even faster machines: 80386 computers, accelerator boards, motherboards, and coprocessor boards. Nearly all companies cite a delay of at least a month or two in shipping schedules, due mainly to a short supply of Intel's 80386 microprocessor. Software companies are pursuing the market nonetheless. Last week we received copies of MetaWare's High C Compiler for the 80386 and Phar Lap Software's 386/ASM, 386/Link, and RUN386 packages. These are now in the hands of BYTE editors, and we expect to give you an early report on the software next month, with full reviews to follow shortly afterward.

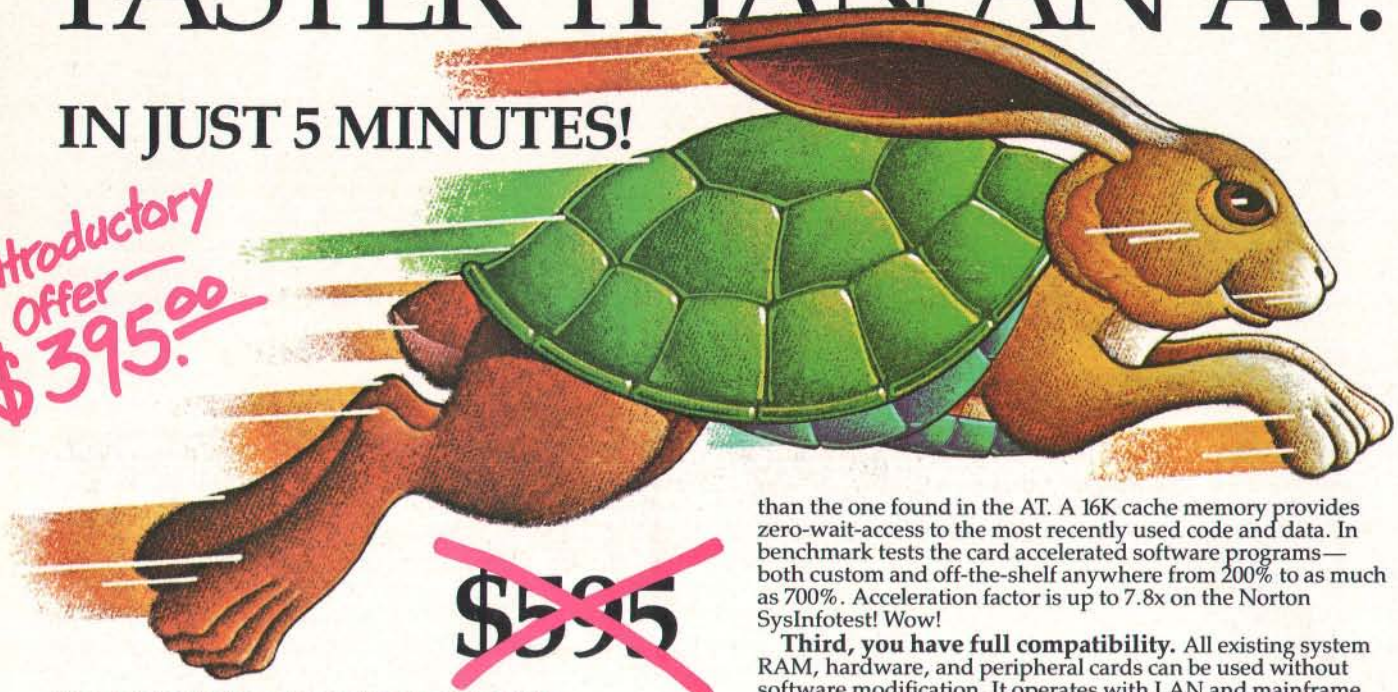
However, the Intel family of microprocessors is not the only one vying for attention. New 68000-based systems from Commodore, Atari, and others have grabbed our attention and that of developers, too, judging from reports from those who attended the MacWorld Expo in January. In addition to presenting the new Amiga 2000 in this month's Product Preview, we'll be evaluating the new Macintosh-compatible portables whose prototypes were shown at the MacWorld Expo: Colby Systems' Lap Mac, Dynamic Computer Products' as-yet-unnamed portable, and Intelitec's MX Plus. All three, reports BYTE's Assistant Managing Editor Glenn Hartwig, use Macintosh motherboards that the companies obtain by buying Macs and dismantling them.

As always, we welcome your comments and suggestions.

—Cathryn Baskin
Senior Technical Editor, Reviews

MAKE YOUR IBM PC FASTER THAN AN AT.

IN JUST 5 MINUTES!



Introductory Offer— $395.00

~~$595~~

DON'T TAKE OUR WORD FOR IT. USE THE BREAKTHRU 286 SPEEDUP BOARD FOR 60 DAYS. IF YOU ARE NOT TOTALLY SATISFIED RETURN IT FOR A FULL REFUND.

It sounds great; the idea of a speedup board that you can just plug right in as easily as putting bread in a toaster. How wonderful to be able to convert a PC or XT to a $4000 AT without the expense. But even when you get ready to spend $595.00 you want to be sure your choice is the very best.

Here at PCSG we sell our IBM PC disk access speedup software by the thousands. But software doesn't do anything about speeding up the microprocessor (or CPU) speed. As you know the microprocessor is the brain of the computer that controls all the operations like screen updates and calculations like a spreadsheet makes.

Faster and smarter than an AT – PCSG guarantees it.

We wanted to offer a speedup card that would be the complement to our disk speedup software, (incidentally included at no extra charge.) We wanted it to be literally the most advanced, compatible and feature rich board available today. We could only be satisfied with a board that was the finest example of the engineering art.

There is no question we have met our every objective by developing and manufacturing the *BREAKTHRU 286* card. This is the best designed and most functional speed up card available today. We guarantee it.

HERE IS WHAT MAKES IT SO SPECIAL.

First, it installs so easily. It is a half slot card, only five inches in length. You don't even have to give up a full slot. What's more, unlike competing products it works in the Compaq and most clones. The instructions are so simple we considered showing a picture of a child putting it in. Easy diagrams show how you just place the card in an open slot, remove the original processor and connect a single cable. There is no software required. From that moment you are running faster than an AT.

Second, it is advanced. The *BREAKTHRU 286* replaces the CPU of the PC or XT with an 80286 microprocessor that is faster than the one found in the AT. A 16K cache memory provides zero-wait-access to the most recently used code and data. In benchmark tests the card accelerated software programs—both custom and off-the-shelf anywhere from 200% to as much as 700%. Acceleration factor is up to 7.8x on the Norton SysInfotest! Wow!

Third, you have full compatibility. All existing system RAM, hardware, and peripheral cards can be used without software modification. It operates with LAN and mainframe communication products and conforms to the Lotus/Intel/Microsoft Expanded Memory Specification (EMS). Software compatibility is virtually universal.

Fourth, it is the best there is. There are several other boards on the market. Some are priced about the same as the *BREAKTHRU 286* and some are cheaper. We at PCSG have compared them all, but there simply was no comparison. What we discovered is that many cards being sold offer only a marginal speed up in spite of their claims. We found some to be merely versions of the obsolete 8088 or 8086, and others to be just poorly engineered. The 8MHz *BREAKTHRU 286* is unequivocally the best executed and most completely reliable speedup board manufactured today.

PCSG has since early 1983 dominated the lap portable market with ROM software such a Lucid spreadsheet and Write ROM that reviewers rated as excellent. We were proud to successfully enter the IBM PC market last year with disk access speedup software. Now we are so pleased with the *BREAKTHRU* speedup card. We use them on our own PC's to make them faster than AT's. We are really excited about this product.

PCSG makes the unabashed statement that the *BREAKTHRU 286* card represents more advanced technology than boards by Orchid, Quadram, Victor, Mountain, P.C. Technologies, Phoenix . . . we could go on.

But an ad can't let you experience it for yourself. That's why we sell the *BREAKTHRU 286* on a 60 day trial. If you aren't completely satisfied return it within 60 days for a full refund. It is priced at $395. Call today with your MasterCard, Visa, American Express or COD instructions and we will ship your card the very next day.

PCSG

PERSONAL COMPUTER SUPPORT GROUP

11035 Harry Hines Blvd. #207 • Dallas, Texas 75229

214-351-0564

master charge · AMERICAN EXPRESS Cards Welcome · VISA

Inquiry 231

A Trio of 8-MHz PC AT Compatibles

Stan Miastkowski

Options, software, and price separate these three machines

In this review, I'll look at three IBM PC AT clones: the NCR PC8, the Victor V286, and the QIC AT-Plus 1800. Although all three systems are similar, each has its own distinctive quirks, and their prices vary drastically.

All three machines that I reviewed were configured with 512K bytes of internal memory, a single 1.2-megabyte floppy disk drive, and an internal full-height 20-megabyte hard disk drive. All had built-in battery-backed clock/calendars. The only major difference in equipment was in the PC8, which came with NCR's own color card and RGB monitor. The AT-Plus 1800 was equipped with a combination monochrome/color card but no monitor, and the Victor V286 had neither a display card nor a monitor. I used a standard monochrome display for reviewing the Victor V286 and AT-Plus 1800 machines, and I swapped the QIC mono/color card between the AT-Plus 1800 and Victor V286 machines. [Editor's note: *See pages 210 and 211 for rent prices and standard configurations of all three machines.*]



The three computers are quite similar to the IBM PC AT in size and appearance. All have the familiar key-operated system locks. As with most PC AT clones, all three take up a great deal of desk space and are best used on large work surfaces or with the system units placed vertically (preferably on the floor). In fact, the nameplate on the PC8 is placed so that it reads horizontally only when the system unit is standing vertically. All three companies thoughtfully provide long keyboard cords for this system-unit-on-the-floor configuration.

The NCR PC8

The PC8 ($3895 and up) is at the top of NCR's line of personal computers; it is the "big brother" to the IBM PC–compatible PC6. [Editor's note: *See the review of the NCR PC6 by Arthur Little in the August 1986 BYTE.*] And "big" is an understatement. The PC8 is the largest and the heaviest of the three systems reviewed. The system unit, though only slightly larger than the other two, weighs nearly 50 pounds. Add the optional RGB monitor and you have a system that tilts the scales at 93 pounds. Ultra-heavy construction is obvious throughout, and the PC8's extra weight can be attributed to the heavy-gauge steel in the case and surrounding the internal components.

The PC8's keyboard is unique in a couple of ways. First, it has a cursor-movement pad separate from the numeric keypad, much like the new IBM "enhanced" keyboard. The separation of the right/left and up/down arrow keys makes cursor control much easier when your eyes are not on the keyboard. The PC8 keyboard also has 30 function keys. Function keys numbered 1 through 10 are standard, keys 11 through 20 are equivalent to shifted function keys 1 through 10, and keys 21 through 30 are equivalent to control function keys 1 through 10. This can be quite handy for involved programs that use many function-key commands. The major oversight on NCR's part is not including a template or some other way of marking the keys. Remembering which of 30 different keys does what can be a major problem, and you're back to keys 1 through 10 if you use a program like WordPerfect that uses Alt/function-key commands.

The PC8 does not have switchable clock speeds; it runs at 8 MHz only. This is becoming less of a hindrance because programs and peripherals that have problems running at 8 MHz are getting rare.

A word about monitors: NCR has a preference for large displays. Its optional high-resolution monitors measure 15 inches (monochrome) and 14 inches (RGB). The RGB display that came with my review unit was a behemoth. Though it looks impressive at first, I found that the combination of the large tube and the nonstandard font used in the system's character-generator ROM made for sore eyes after a couple of hours. Pushing the monitor farther away helped a bit, but I'd hate to have to use the RGB display for eight hours a day. A standard mono-

continued

Stan Miastkowski is an associate news editor for BYTE and editor in chief of the McGraw-Hill Microcomputer Handbook. *He can be reached at BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.*

chrome display is considerably easier on the eyes.

The Victor V286

The V286 ($2195 and up) is a well-constructed AT clone. Of the three systems reviewed, it's the most complete in its off-the-shelf configuration. Both a serial port and a standard parallel printer port are built into the system board, with jacks accessible on the rear panel. The only drawback is that, like the IBM PC AT it emulates, the serial port uses a small DB-9 connector instead of the previously standard DB-25. You might have to hunt around to find a serial cable that fits.

The V286 also has the most on-board memory-expansion capability of the three computers. Standard memory consists of 512K bytes, and sockets are included for another 512K. Of the two dual-speed systems, the V286 is the only one that's easily switchable between 6-MHz and 8-MHz clock speeds (via a slide switch on the rear panel).

The V286 keyboard is the standard PC AT type with ten function keys. Its one unique feature is an extended palm rest in front of the first row of keys. Though this is supposed to be an ergonomic feature for touch-typists, I found it difficult to get used to since I use my palms on the edge of the keyboard to orient my typing fingers.

The QIC AT-Plus 1800

The AT-Plus 1800 is the lowest-priced computer of this trio. The basic unit retails for $1295. For that price you'll get a system that still needs a monitor card and monitor, I/O ports, and software. But even when you add all these, you'll still end up with a low-cost system. The unit I reviewed came with the Everex Edge, a combination monochrome/color board with features like Hercules compatibility and a number of useful utilities that allow you to display 48-row by 132-column text.

The AT-Plus 1800 is a no-frills, well-constructed system. Its major idiosyncrasy is the effort needed to change the clock speed. The system comes with the 8-MHz crystal installed. If you want to switch to 6 MHz, you'll need to replace the crystal, which is mounted in a socket. A crystal for 6 MHz is included, and access isn't difficult. However, you'll need to slide off the system unit cover to get to it. Then there's the problem of keeping the tiny crystal somewhere where it won't be misplaced.

Setup

The unpacking and setup chores for these machines varied greatly. The setup of the NCR PC8 was the most time-consuming

continued

PC8

Company
NCR Corp.
Personal Computer Division
1700 South Patterson Blvd.
Dayton, OH 45479
(513) 445-7478

Size
6¼ by 21¼ by 17 inches; 50 pounds (system unit and keyboard)

Components
Processor: 8-MHz 80286
Memory: 640K bytes (basic system), expandable to 1.2 megabytes with 512K-byte memory-expansion board
Mass storage: One double-sided 360K-byte floppy disk drive and one 20-megabyte hard disk (basic system); one 1.2-megabyte floppy disk drive and one 20-megabyte hard disk drive (enhanced system)
Display: 15-inch monochrome or 14-inch RGB (both 640 by 400 pixels and 80 characters by 25 lines); both optional
Keyboard: 112 keys; 30 function keys; indicator lights for Caps Lock, Num Lock, and Scroll Lock keys
Expansion: Eight slots: six IBM PC AT-compatible; two IBM PC-compatible
I/O interfaces: One serial port and one parallel printer interface (enhanced system)

Software
NCR-DOS (MS-DOS 3.1-compatible); GW-BASIC; User Diagnostics disk; Getting Started disk

Options
RAM expansion kit; 30-megabyte hard disk drive; 64-megabyte hard disk drive; 720K-byte 3½-inch disk drive; high-resolution monochrome or RGB monitor; standard-resolution monochrome or color monitor; tilt-and-swivel monitor stand

Documentation
Owner's manual; NCR-DOS manual; GW-BASIC manual; *Getting Started* manual

Price
Standard system with single 360K-byte floppy disk, 20-megabyte hard disk, and 640K bytes of memory: $3895
Enhanced system with single 1.2-megabyte floppy disk drive, 20-megabyte hard disk drive, and 640K bytes of memory: $3995

Victor V286

Company
Victor Technologies Inc.
380 El Pueblo Rd.
Scotts Valley, CA 95066
(408) 438-6680

Size
5¾ by 21¼ by 17 inches; 43 pounds (system unit and keyboard)

Components
Processor: 6-MHz or 8-MHz 80286 (switch-selectable)
Memory: 512K bytes, expandable to 1.2 megabytes on motherboard
Mass storage: One double-sided 1.2-megabyte floppy disk drive; 20-megabyte hard disk drive (optional)
Display: Monochrome (80 characters by 25 lines) or RGB (640 by 200 pixels); both optional
Keyboard: 83 keys; 10 function keys; indicator lights for Caps Lock, Num Lock, and Scroll Lock keys
Expansion: Eight slots: six IBM PC AT-compatible; two IBM PC-compatible
I/O interfaces: One serial port and one parallel printer port; both built into motherboard

Software
MS-DOS 3.1; VBASICA; diagnostics program; setup program

Options
20-megabyte hard disk drive; memory-expansion board; monochrome card or monitor; color card or monitor

Documentation
User's guide; MS-DOS 3.1 reference guide; VBASICA manual

Price
Basic system (single 1.2-megabyte floppy disk drive and 512K bytes of memory): $2195
Basic system with monochrome card and monitor: $2495
Basic system with color card and monitor: $2795
Enhanced system (single floppy disk drive, 512K bytes of memory, and 20-megabyte hard disk): $2995
Enhanced system with monochrome card and monitor: $3195
Enhanced system with color card and monitor: $3595

AT-Plus 1800

Company
QIC Research Inc.
489 Valley Way
Milpitas, CA 95035
(408) 942-8086

Size
6 by 21¼ by 16½ inches; 40 pounds (system unit and keyboard)

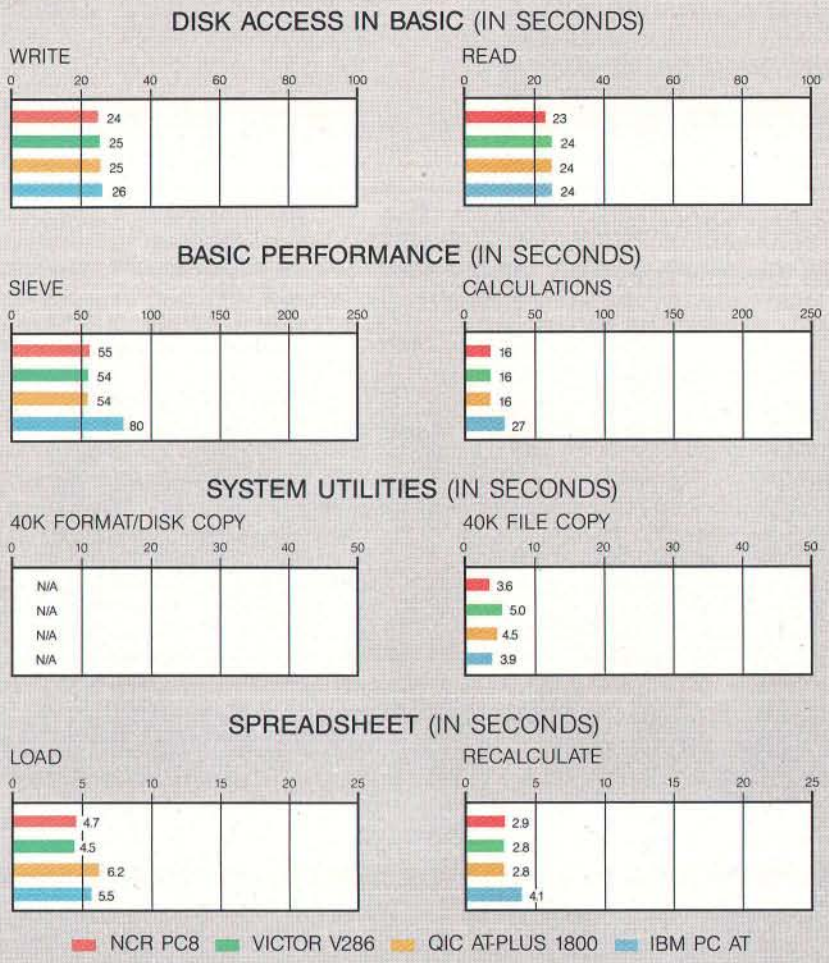
Components
Processor: 6-MHz or 8-MHz 80286, selectable by changing crystal
Memory: 512K bytes, expandable to 1 megabyte on motherboard
Mass storage: One double-sided 1.2-megabyte floppy disk drive; 20-megabyte or 30-megabyte hard disk optional
Display: Not included
Keyboard: 83 keys; 10 function keys; indicator lights for Caps Lock, Num Lock, and Scroll Lock keys
Expansion: Eight slots: six IBM PC AT–compatible; two IBM PC–compatible
I/O interfaces: Not included

Software
Setup disk

Options
MS-DOS 3.1; 20-megabyte or 30-megabyte hard disk drive; monochrome card; monochrome/color card; EGA card; multifunction card; RAM expansion board; cartridge or cassette-tape hard-disk backup

Documentation
Operations manual

Price
Basic system with single 1.2-megabyte floppy disk drive and 512K bytes of memory (no I/O interface or monitor adapter): $1075
Expanded system with single floppy disk drive, 512K bytes of memory, 20-megabyte hard disk drive, multifunction card, monochrome/color card, and MS-DOS 3.1 (no monitor): $1699



The graphs for Disk Access in BASIC show how long it takes to write and then read a 64K-byte sequential text file to a blank floppy disk. (For the program listings, see BYTE's *Inside the IBM PCs*, Fall 1985, page 195.) The Sieve graph shows how long it takes to run one iteration of the Sieve of Eratosthenes prime-number benchmark. The Calculations graph shows how long it takes to do 10,000 multiplication and 10,000 division operations using single-precision numbers. The System Utilities graphs show how long it takes to copy a 40K-byte file using the MS-DOS COPY command. The Format/Disk Copy test was omitted since all three systems were single floppy disk systems. The Spreadsheet graphs show how long it takes to load and recalculate a 25- by 25-cell spreadsheet in which each cell equals 1.001 times the cell to its left. The spreadsheet used was Microsoft Multiplan. All BASIC benchmark programs were run using GW-BASIC.

All three systems had compatibility problems. None would run version 2.12 of Flight Simulator, a de facto standard IBM PC–compatibility test.

due to the large number of individually boxed components. Even though the setup instructions were clear, it took well over an hour to get the system put together. The Victor V286 and QIC AT-Plus 1800 were much simpler. With them it was simply a matter of installing the display board and plugging in the monitor, AC power, and keyboard. Setting up all the units required that their system unit covers be removed. All of them slide off, but you need to remove screws. Once you have the hardware set up, you have to run the respective setup program that configures the hard disk and tells the system what options it contains.

Compatibility

All three systems had compatibility problems. None would run version 2.12 of Microsoft Flight Simulator, the de facto standard IBM PC–compatibility test. In all three cases, the systems just locked up. Although they failed this classic test, I encountered few problems with other software, especially contemporary programs without copy protection. All ran flawlessly at 8 MHz. Older programs with copy protection, such as an early version of Lotus 1-2-3, had some problems at 8 MHz. In most cases, setting the clock speed back to 6 MHz cured the problem. The PC8 runs only at 8 MHz, so it cannot be made compatible with software that demands a 6-MHz speed.

Option cards can have similar problems. Once again, older cards are the main culprits. Most cards designed for the IBM PC simply won't work with the new high-speed clones. Changing the clock speed to 6 MHz on the Victor V286 and QIC AT-Plus 1800 will sometimes solve the problem, but more often than not it won't. The same goes for early PC AT–style cards.

Nearly all cards made in the last year or so work at 8 MHz with no problems. A word to the wise: If you intend to purchase one of these clones, don't assume that your current cards will work. If you're planning on purchasing new cards, be sure you can get your money back if they don't work.

Keyboards

Working with the keyboards of these three systems proved that this essential human-to-computer interface isn't a high priority among system designers. Although the PC8 keyboard has extra function keys, it joins the other two in having a touch that's just plain mushy. Although the touch of a particular keyboard is a very subjective call, I think that all three keyboards don't have strong enough springs under their keys. Most serious typists prefer the tactile feedback of a stiffer keyboard. All the keyboards reviewed here have a decidedly cheap feel to them, and I wouldn't want to use any of them for my day-to-day writing.

Software

The software included with the three systems varies greatly. The AT-Plus 1800 that I reviewed didn't come with an operating system, but I used MS-DOS 3.1 with no problems. The system had hard disk setup, format, and head-parking utilities included on a single floppy disk. A second disk had a setup utility for configuring the system.

The AT-Plus 1800 was the only system of the three that doesn't come with a diagnostics disk. Although the lack of specific system-tuned diagnostic programs is a slight handicap, numerous commercial diagnostic programs, such as The Norton Utilities, are available if you have a need for that feature.

Both the V286 and PC8 systems come with extensive software. Included are setup programs, diagnostics, operating systems, and BASIC. Both systems run versions of MS-DOS 3.1. NCR calls its operating system NCR-DOS, and Victor keeps the MS-DOS name. Both run identically to the IBM release and include the standard utilities. Both computers also include GW-BASIC, although Victor has named its version VBASICA.

The PC8 also comes with a Getting Started disk, essentially a guided tour of the machine and its capabilities. Though a nice touch for those with little computer experience, it doesn't contain useful information for advanced users.

Documentation

All three machines come with extensive documentation and, although the quality varies, it's all usable.

NCR's documentation is the most disappointing, especially for those who are more technically inclined. The NCR-DOS and GW-BASIC manuals are useful, but the owner's manual is a hair-pulling example of worthwhile information hidden in a torrent of words. The "Technical Data" section at the end of the book is just a couple of pages of information that is nearly useless.

The V286 documentation is extremely well done. The only problem is a lack of technical information. Victor's telephone-support staff was very helpful with my advanced questions, but I had to pay for a long-distance call.

Because the AT-Plus 1800 doesn't come with either an operating system or BASIC, its documentation is the smallest of the group. Considering the system's bargain-basement price, I was more than a little surprised to find the operations manual to be by far the best of the group. Technically inclined users will find detailed information on everything from keyboard scan codes to connectors and I/O addresses. In a pinch, this type of information can be invaluable if problems develop.

Performance

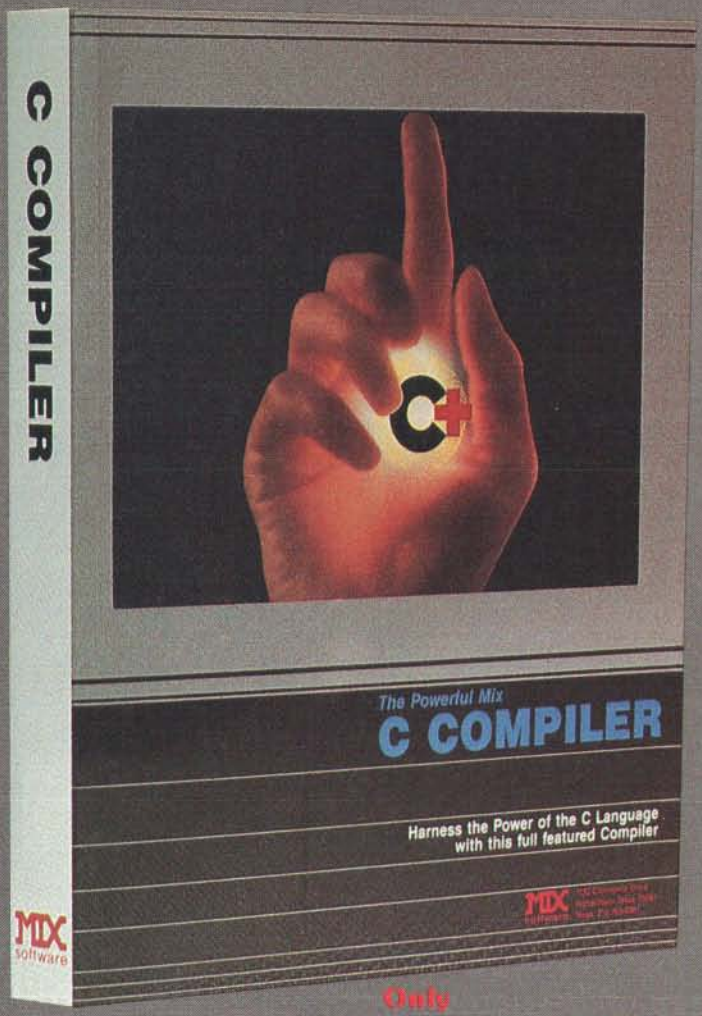
Comparing the performance of these three systems is an exercise in splitting hairs. As the benchmarks show, all the systems are nearly identical in performance, with differences of a second or less on many of the benchmarks (see page 211). But differences of a few tenths of a second don't add up to much over the course of a day at the keyboard.

Weighing the Pros and Cons

Which of these three PC AT clones is the best? Unfortunately, given the similarities in features and performance, that question is a difficult one to answer. Your decision should be based on price, reputation, product support, and service.

Although the NCR PC8 is the most solidly built of the systems, the slight edge in quality doesn't outweigh the fact that it's the most expensive. The Victor V286, though not the least expensive, is the most complete of the systems. And my prior experience with the support offered by Victor has shown that it will bend over backward to help its customers.

The QIC AT-Plus 1800 is the least expensive of the systems. But because making it into a useful system requires choosing from a wide range of peripherals, it's not a system for the completely inexperienced or for those who want the closest thing to a "plug-in-and-go" system. QIC is by far the smallest company of the three mentioned here. Although my experience with its customer service was positive, you might want to consider its long-term support potential. However, if you're an experienced computer user on a tight budget, the AT-Plus 1800 is by far the best value. The choice is yours, and with more PC AT clones appearing regularly, it's not going to get any easier. ■



C for yourself

Get off to a fast start with MIX C. Our comprehensive book and nimble C compiler will have you programming in C before you know it.

Our book is your teacher. You'll start right away, compiling and executing C programs. The tutorial takes you step by step through the C language. You'll learn by example with a book that's chock-full of sample programs. And the programs aren't just fluff. They teach you the important C concepts. An amortization program teaches you how to use pointers to functions. A data base program teaches you how to manage memory dynamically. It's the best hands on training available.

You'll love working with our C compiler. It's half as large and twice as fast as other C compilers. In fact, it's the only full featured C compiler that can be operated comfortably on floppy disks. And as you would expect, MIX C is easy to use. It produces a complete program listing with compile errors clearly identified and explained. If you've been frustrated by other C compilers, don't throw in the towel until you've tried ours. There's a big difference.

Although it's small, MIX C is not a subset. MIX C supports the full K&R standard, including the extensions that are often omitted in other C compilers. MIX C comes complete with a comprehensive book, a standard library of more than 175 functions, a blazingly fast linker, and tools for optimizing your programs for minimal space or maximum speed. All of this is yours for the incredibly low price of $39.95. That's little more than the cost of most C books alone. So don't be left behind. Order your copy today and find out why everyone is switching to C.

TO ORDER CALL TOLL FREE: 1-800-523-9520 For technical support and for orders inside Texas please call (214) 783-6001 Or Contact one of our Distributors in Canada: Saraguay 1-800-387-1288 • France: Info/Tech 1-43-44-06-48 • Australia: Techflow 047-586924 • Switzerland: DMB Communication CH-0-523-31817 • England: Analytical 04215-62099.

System Requirements: MSDOS/PCDOS 2.0 or higher; 256K Memory; 1 Disk Drive or CP/M 2.2 or higher (Z80); 55K Memory; 1 Disk Drive (2 recommended) (Ctrace not available for CP/M)

Only **$39.95**

CTRACE DEBUGGER $39.95

The perfect companion for MIX C is our exciting new C source debugger. Ctrace is unlike any debugger you've ever seen. It brings your programs to life on the screen. You'll see your variable values changing as you watch your C source code executing. The animated trace shows you the flow of execution, statement by statement. It's like watching the bouncing ball as the cursor dances over your C program.

Ctrace is very simple to operate. Commands are executed with a single keystroke. Pop up menus list the command options. Pop up messages alert you when anything important happens. There are 6 windows of information: source, output, variables, watch, memory, and symbols. You can view as many as 4 windows at once. The function keys make it easy to quickly choose among 8 different views.

The combination of Ctrace with MIX C makes C programming a real joy. MIX C provides the power of a compiler while Ctrace provides an execution environment that's more elegant than an interpreter.

SPLIT-SCREEN EDITOR $29.95

Another great companion to the MIX C compiler is our split-screen editor. It makes writing programs even faster and easier. With the MIX Editor, you can compile, link, and execute your program at the touch of a key. Compiling is fast because the MIX C compiler reads the program directly from memory. Correcting errors is easy because the editor automatically positions the cursor to the first error in the program. The editor is similar to Micropro's WordStar but with additional programming features like split-screen, macros, and much more. Use it for all of your programming needs.

ASM UTILITY $10.00

Our ASM utility is available if you want to link assembly language functions to your C programs. It works with Microsoft's MASM or M80 assemblers. Call assembly language functions just like C functions. Call C functions from assembly language. Lots of useful assembly language functions are included as examples.



The MIX C Works
Only $89.90

Save $29.95 on the Works includes Editor, C Compiler, Ctrace, & ASM Utility

Product	Price	Total
_Ctrace	($39.95)	$ _____
_C Compiler	($39.95)	$ _____
_ASM Utility	($10.00)	$ _____
_Split-Screen Editor	($29.95)	$ _____
_The MIX C Works (includes all of above)	($89.90)	$ _____
Subtotal		$ _____
Texas Residents Add 7.25% Sales Tax		$ _____
Add Shipping Charges		$ _____

In USA: add $5 per order
In Canada: add $10 per order
Overseas: add $10 for editor
add $20 for compiler
add $30 for Works

Total of Your Order $ _____

30 Day Money Back Guarantee
Not Copy Protected

Please check method of payment
__Check __Money Order __MC/VISA
Card # _____
Expiration Date _____
Please give name of computer
_____
Please check operating system
__ MSDOS/PCDOS __ CP/M
Please check disk size
__ 5¼" __ 3½" __ 8"
Please check disk format if CP/M
__ SSSD __ SSDD __ DSDD
Your Name _____
Street _____
City _____
State _____ Zip _____
Telephone (_____) _____-_____
Country _____

MIX software
1132 Commerce Drive
Richardson, Tx 75081
(214) 783-6001

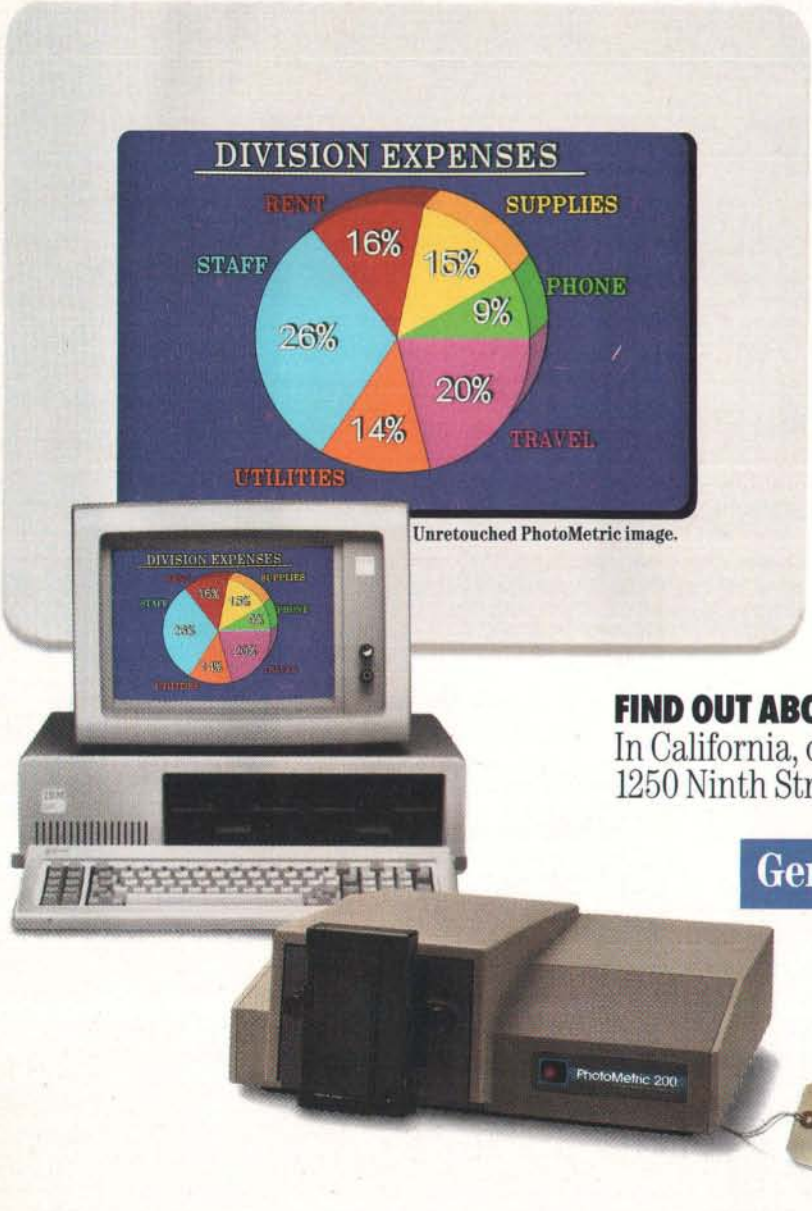
Ask about our volume discounts!
Dealer Inquiries Welcome

B

NEW

PhotoMetric 200™

THE LEADING DESK TOP SLIDEMAKER



Unretouched PhotoMetric image.

TERRIFIC SLIDES FROM POPULAR SOFTWARE.
Use any popular graphics package like Lotus Freelance,™ Microsoft Chart 2.0,™ Ashton-Tate Chart-Master,™ our popular PictureIt™ and many more. Call for the list.

2000 x 2000 RESOLUTION SLIDES IN 1000 BRILLIANT COLORS.
Everything you need: PhotoMetric 200 Desktop Film Recorder, PC Board and PhotoMetric software. All for $5995.

FIND OUT ABOUT IT. Call 1-800-556-1234, Ext. 533. In California, call 1-800-441-2345, Ext. 533. Or write 1250 Ninth Street, Berkeley, CA 94710.

General Parametrics Corporation
the makers of VIDEOSHOW™

Also available: PhotoMetric 200VS for use with VideoShow 160.

VideoShow, PhotoMetric and PictureIt are trademarks of General Parametrics Corporation. Freelance and Lotus are registered trademarks of Lotus Development Corp. Chart 2.0 is a trademark of Microsoft. ChartMaster is a trademark of Ashton-Tate. IBM is a trademark of International Business Machines Corp.

Inquiry 118 for End-Users. Inquiry 119 for DEALERS ONLY.

AT&T's TrueVision Image Processing System

Robert Tinney

A package for digitizing and manipulating video images

AT&T's TrueVision image processing system, a plug-in board and software combination, uses a video camera, an IBM PC or compatible, and a graphics tablet or mouse to capture, digitize, and manipulate real-time images on a color monitor. The system produces pictures that are clean, sharp, and as good as regular television pictures. I jumped at the opportunity to use the system to produce several sketches and finished illustrations for this issue of BYTE (see pages 82, 140, 204, and 248).

I should emphasize that since I'm an illustrator, I'm more interested in the painting than the video capabilities of this system, which is basically designed for producing video images. The system lets you, for instance, overlay text on video with flair and variety. Also, since my expertise is art and not computers, this review is more application-oriented and focuses less on the system's technical aspects.

TARGA and TIPS

AT&T offers a variety of TrueVision products from its Electronic Photography and Imaging Center in Indianapolis, Indiana. The TrueVision system I reviewed consisted of the TARGA 16 full-length board and TIPS software, also available from AT&T. The TARGA (TrueVision Advanced Raster Graphics Adapter) series consists of five cards that range in price from $1595 to $4995. At $2995, the TARGA 16 is the mid-priced board of the series. It's a combination frame grabber and buffer, featuring 512- by 482-pixel resolution and simultaneous display of 32,768 colors.

TIPS (TrueVision Image-Processing Software) is a product of Island Graphics in Sausalito, California. TIPS is not copy-protected and comes on two floppy disks that are easily transferred to hard disk. The software differs somewhat among the various boards; the version for the TARGA 16 board retails at $1250. As you can see, neither the hardware nor the software for this system is inexpensive, particularly when you figure in everything needed for a complete system, such as mouse or graphics tablet. Still, considering what similar graphics capabilities would have cost only two or three years ago, the price is reasonable.

For this review, I used the TARGA 16 and TIPS with the following equipment: an AT&T PC 6300 equipped with a 20-megabyte hard disk, one floppy disk drive, and MS-DOS 2.11; an AT&T monochrome monitor; a 20-inch Sony Trinitron KV-2011CR television set with both analog RGB and composite modes; a JVC GX-N8PC(U) color video camera with an RGB attachment; and a Summagraphics MM1201 SummaSketch graphics tablet with a 12- by 12-inch drawing area.

The documentation states that the TrueVision system runs on an AT&T PC 6300, PC 6300 Plus, or an IBM PC, XT, AT, or compatible with at least 512K bytes of RAM. The system also ran on my own PC AT clone, which I will describe later in this review. A computer with dual 360K-byte floppy disks can run the system, but the user's guide recommends a hard disk for greater storage capacity, speed, and flexibility in manipulating images. The TIPS software also works with a Lotus/Intel/Microsoft expanded-memory board with at least 1.5 megabytes of memory. The extra RAM is used to provide an Undo option for the last action taken and for full-screen rather than partial-screen manipulation for certain other functions.

To get the system up and running, you plug the TARGA board into your computer, connect a video source (such as a video camera or VCR with a 9-pin connector) to the input port of the board, and plug a color monitor (RGB analog or composite with a 9-pin connector) into the board's output port. You must also hook up a standard monochrome or color monitor in the usual way for displaying error and other operating messages. A serial port on the computer is required for a graphics tablet or other pointing device.

Using the System

I began familiarizing myself with the TrueVision system by going through the tutorial section of the TIPS user's manual. The documentation is clear, and manipulating the digitizing pen quickly becomes intuitive. I didn't find it at all awkward to relate the pen movement on the pad to the cursor movement on the screen. If you've ever used a mouse, you know that hand/eye/screen coordination comes quickly and naturally.

It's not so easy to get comfortable with screen flicker, however. After I worked with the system for about an hour I found myself squinting at the screen, and I realized that the flicker was tiring my eyes. This never became a major problem (no headaches), but it was an annoyance. The flicker was caused by the TARGA sending an interlaced signal to the monitor, although the board can support noninterlaced signals at lower resolutions (512 by 256 or 256 by 256 pixels). The Sony monitor that I used performed admirably in all other respects. Its colors were crisp, objects were sharp-edged, and the range of intensities was excellent (the blacks were very black, and the whites were very white).

The TIPS user interface is a hierarchy of menus and submenus that are visible when in use but hidden during most actual operations. You give the system almost all commands through menu selections, including grabbing video images

continued

Robert Tinney (1864 North Pamela Dr., Baton Rouge, LA 70815) is an illustrator who has designed many of BYTE's covers since its first issue in 1975.

AT&T TrueVision Advanced Raster Graphics Adapter (TARGA 16)

Type
High-resolution color video digitizer and display board

Company
AT&T
Electronic Photography and Imaging Center
7351 Shadeland Station, Suite 100
Indianapolis, IN 46256-3921
(800) 858-8783

Size
4 by 14 by ¾ inches (without Overscan option)

Features
512- by 482-pixel resolution; palette of 32,768 colors; ability to overlay computer-generated graphics on a video image; image-capture rate of 1/60 second per field or 1/30 second per frame; comes with installation and demonstration programs on disk

Necessary Hardware
IBM PC, XT, AT, or compatible with at least 256K bytes of RAM; hard disk drive recommended; analog RGB monitor (recommended), composite video monitor, or color TV with RF adapter; standard monochrome or color monitor; video disk player, video camera, VCR, or other video source that generates standard NTSC composite video or RGB signals (optional)

Necessary Software
MS-DOS 2.0 or later

Options
Overscan option (for video output): $200 when ordered with board or $300 if purchased later; TARGA Software Tools (C language utility library): $25 (free if requested when you purchase the board); PC Carousel (slide-show package): $150; TV Picture Power (image database): $995

Documentation
125-page manual including user's guide and technical reference manual

Price
$2995

AT&T TrueVision Image-Processing Software (TIPS) version 3.1

Type
Video digitizing and editing package

Company
AT&T
Electronic Photography and Imaging Center
7351 Shadeland Station, Suite 100
Indianapolis, IN 46256-3921
(800) 858-8783

Format
Two 5¼-inch floppy disks

Computer
IBM PC, XT, AT, or compatible with 512K bytes of RAM and two floppy disk drives or one hard disk drive (recommended); TARGA 16 board; standard monochrome or color monitor; composite video monitor, analog RGB monitor (recommended), or TV with RF adapter; any NTSC analog RGB or composite video input source; AT&T Mouse or Microsoft Mouse; Summagraphics MM961 or MM1201 or Bit Pad One–compatible graphics tablet; Lotus/Intel/Microsoft expanded-memory board with at least 1.5 megabytes of memory (optional)

Language
C

Options
TrueVision fonts for TIPS (additional 30 fonts): $100

Documentation
220-page user's manual including tutorial, user's guide, and glossary

Price
$1250

with a camera and moving digitized images to and from disk. There are some exceptions; for example, you can change brush colors without retreating to a menu, and you can quickly access the zoom function sans menu. Using the menu structure is very fast, however, particularly after you get a feel for its layout. It is an icon-based system, as you would expect in a graphics program, and zipping through the various levels is just a matter of clicking on one symbol and then another.

Displayed along with the menus is the color palette, which shows 256 colors out of the 32,768 available. You can adjust this palette endlessly to your requirements; if you need to work with more than 256 colors, you merely save the current palette to disk and begin building another one. Switching back and forth among various palettes takes only a few seconds.

Image Manipulation

TIPS places a wealth of functions for manipulating an image at your disposal. Their sheer number and the subtle, and sometimes unexpected, ways in which they can interact makes cataloging and describing them difficult. I've used the system for 3½ weeks, and I'm sure I haven't fully explored many capabilities. What I'll do here is comment on the major functions and hint at some of the rest.

• **Drawing Functions.** The system lets you automatically draw rectangles and ovals (either filled or outlined), straight lines, triangles, curves, arcs, parallelograms and, of course, freehand shapes. The speed is good; even in freehand mode it's difficult to make the cursor lag behind your pen movements unless you select a really large brush. All the above can be done in nearly any color imaginable, as well as in any number of patterns. A menu of patterns comes with the system, and you can create your own or build a library of them if you prefer.

The zoom function deserves special mention, since I found myself doing much of my drawing with it. The function has three levels, and you access all of them from the keyboard by striking the appropriate single key. The first zoom level is twice normal size, the second is four times normal size, and the third is eight times normal size. All drawing functions (and most of the others) are available in zoom, which allows pixel-by-pixel editing at all levels. One nice feature is that any level of zoom automatically pans over the entire screen, following your cursor movements. This eliminates the need to continuously punch in and out of zoom when moving to various areas of the screen.

• **Special Effects.** Want to take a part of an image and move it somewhere else on the screen? Want to reproduce it 10 or 20 times or enlarge or reduce it? How about flipping it left to right, top to bottom, or rotating it only slightly? Using traditional media, all the above actions would be tedious and time-consuming. With computer graphics they're fun, and with the TrueVision system they're fast. Speed and flexibility in these types of operations are significantly increased with the addition of an expanded-memory card because more or all of the image is stored in RAM.

• **Text Fonts.** TIPS comes with a variety of text fonts, both serif and sans serif. You

can adjust the size of the font, the direction it prints on the screen (including backward and at odd angles), and the color. You can even print text so that it rotates either clockwise or counterclockwise, and it can be antialiased; that is, you can smooth out its "jaggies" with appropriate gradations in color along its edges (as you can with most other TrueVision images). Text can also appear with either solid or translucent shadows, making it appear to jump out from the screen.

The spread function and the airbrushing, blending, tinting, and antialiasing functions feature the TrueVision system's ability to automatically fill in subtle, incremental changes of color. Here the TARGA 16's 32,768 colors really shine. If you select the airbrushing function, for example, and apply a blue color, TIPS draws from its array of possible colors and adjusts every pixel under the "spray" to a color with a blue index slightly higher than the one it currently has. More blue is added to the pixels under the center of the brush than to those near the edges, giving the added tint a feathered-out appearance. Moving a blending brush over an edge between two colors directs TIPS to draw from its full palette and fill in a range of colors intermediate to the original two, and the edge becomes blurred.

It's inevitable that in this short review I can mention many of the more subtle features of such a complex system only briefly. The TrueVision system can mask areas of the screen from special effects (so that you can, for instance, airbrush around an object). It provides a grid to facilitate placing objects in precise locations and lets you pixelize any area of the screen with the block size you specify to give the image the mosaic appearance of a computer-generated image. The system can also perform quick loads and quick saves to hold copies of images temporarily in memory while you experiment with them.

Easy Operation

Disk operations are included within the TIPS menu hierarchy and are easy to carry out quickly. To save the image on the screen, you simply choose the disk icon, select Save from the submenu, type in a filename for the image, and press Return. If you are saving to an existing file, all you do is click on its listing in the menu. I timed both the Load and Save actions (the time the image spent going to and from disk, not counting time spent in the menu) for a full-screen image and found both to be about 9.3 seconds. This is very good, especially since I've used floppy disk–based systems that demanded 40 to 60 seconds for the same operations.

A typical 512- by 400-pixel full-screen image takes up about 400K bytes of disk space, limiting the size of an image you can store on a floppy disk. However, TIPS gives you the option of saving to a compressed file, which shrinks a 400K-byte image to as small as 100K, depending on the image. You can save not only full screens to disk, but also windows (you select the area with a rubber-band box), patterns, colors (to supplement the palette on the menu), masks, brushes, and text fonts.

I was interested in seeing how compatible the TARGA 16 board would be with other machines besides the AT&T PC 6300, so I tried plugging it into my no-name PC AT clone. The TARGA 16 is a single-slot full-length board and, with the Overscan option for video output, it's thick enough to require two slots (it has three levels). However, when I put it into the last slot in my machine, I discovered that the board's third deck is located so that it cleared my hard disk drive unit. My computer is a fairly typical configuration. Thus, even with its Overscan option, the TARGA can take up only one slot, depending on the host machine.

Since the TARGA board that I reviewed came already installed in the PC 6300, it was seated in an 8-bit IBM PC–style slot. However, when I pulled the board out, I saw immediately that it was configured with an extension to fit in and take full advantage of a 16-bit PC AT slot. That's where I installed it in my PC AT clone, and it worked just fine. I tested all the functions of the system including loading and saving and found no hang-ups. In fact, the major difference I noticed was that loading and saving operations averaged around 4.6 seconds in my PC AT clone, about half the time of the PC 6300.

More Colors, More Pixels

As an illustrator interested primarily in print media, I'd rate the AT&T TARGA 16 TrueVision system as fantastic for sketching and conceptualizing, but only fair for my style of finished artwork. The power to quickly create, change, and save multiple versions of a sketch makes this system an amazing creative tool. For finished artwork, I'd suggest only two improvements: more colors and more pixels.

Although 32,768 colors may seem like a lot, I discovered that the airbrushing and blending functions didn't supply enough levels from one color to another; if two adjacent colors were fairly close in appearance, blending had little effect. I'd also like to see considerably higher resolution (perhaps 2000 by 2000 pixels). Actually, AT&T has already obliged my first requirement, because the next board up in the series, the TARGA 24 ($3995), sports 16,777,216 simultaneous colors.

As far as video is concerned, TrueVision already has all the resolution it needs to do an amazing job of capturing and manipulating television-quality images. ■

Four Laser Printers

Arthur Little

The Canon LBP-8, the BDS Model 630/8-E, and the QMS Kiss are all built around the Canon laser engine. The Quadram QuadLaser is built around the Ricoh laser engine. The engine is the electromechanical black box responsible for putting an image onto paper. The selection of one graphics engine over another largely determines factors such as print quality, dot density, and printing speed. Other features, such as font availability and programmability (the intelligence of a printer), are external to the engine. These intelligence features distinguish one company's laser printer from another.

The key intelligence features of these laser printers are emulation modes and onboard memory. Emulation modes determine how likely it is that a printer will work with existing applications software—primarily word processors and graphics packages. Emulation modes enable a laser printer to respond almost exactly as the emulated printer would to a variety of formatting, type style, and other printer commands. The amount of on-board memory largely determines how large a graphic image a printer can handle. All these printers are capable of printing 300 dots per inch, but not all of them have enough memory to hold a full page of such data. Approximately 1.5 megabytes is needed for an 8½- by 11-inch page with no data compression. However, most graphics don't require anywhere near that much memory. Many images such as bar and pie charts do not require 300 dpi, nor do they take up a full page.

Other important features of laser printers are the availability of typefaces in a variety of sizes and the method for adding new typefaces, either via cartridges containing ROM-stored fonts or via down-

continued

loading from the host computer. In any case, it is desirable to have the fonts provided in disk or cartridge by the company because creating your own font is an extremely time-consuming and tedious process.

The Canon LBP-8

Canon offers two versions of the LBP-8, which are designated A1 and A2 and sell for $3000 and $4300, respectively. The A2 is an enhanced A1 and has more memory, a vector printing mode, and an extended area-fill, or paint, mode. I tested the A1 model for this review. Unless specifically noted otherwise, references in this review to the LBP-8 apply to both models.

The LBP-8 emulates the Diablo 630 daisy-wheel printer and accepts the full set of ISO printer commands, which are versatile but not commonly used in the United States. If your word processor does not support Diablo 630 printers or the ISO standard, you'll need to write your own printer driver or ask the word processor company for one. The other laser printers reviewed offer a wider variety of emulation modes, such as Epson FX-80 and Qume Sprint emulation.

The LBP-8 comes with four built-in character sets, or fonts, and it accepts ROM cartridges that provide additional fonts. I did not test the cartridges for this review.

Canon refers to the built-in character sets collectively as Courier Normal typeface ("normal" means a vertical page orientation; it is also called portrait mode). The four Courier fonts are 10-character-per-inch roman, 10-cpi bold; 10-cpi italic, and a reduced-size roman for use in footnotes, subscripts, and superscripts.

Eight additional font cartridges are available for $230 each: Courier 10 in normal and rotated, or horizontal "landscape," versions, Pica 10 in normal and rotated versions, Elite 12 in normal and rotated, Garland Proportional in normal and rotated, and a single-line printer cartridge containing some normal and rotated character sets.

Additionally, the LBP-8 will accept user-defined fonts downloaded from a host computer, subject to the memory limitations of the printer. The A1 comes with 128K bytes of memory; the A2 has 1.125 megabytes.

You can change fonts manually using the buttons on the front panel of the LBP-8 or via commands from the host computer. Unfortunately, Canon does not provide a utility program to simplify the process of font selection and mode control. The only help is some general instructions in the user's manual.

LBP-8 A1 and A2

Type
Laser printer

Company
Canon U.S.A. Inc.
One Canon Plaza
Lake Success, NY 11042
(516) 488-6700

Size
18¾ by 11½ by 16½ inches without trays; 28½ inches deep with both trays in place; 70½ pounds

Features
Diablo 630 and ISO emulation; manual or cassette feed; multiple fonts; landscape or portrait orientation; combined drum/toner cartridge; 100-sheet tray; A1 prints graphics at 300 dpi for partial page only; A2 prints graphics at 300 dpi in full-page mode; A1 has 128K bytes of memory; A2 has 1.125 megabytes of memory.

Options
Additional font cartridges: $230 each

Documentation
User's manual, 206 pages

Price
A1 $3000; A2 $4300

Model 630/8-E

Type
Laser printer

Company
BDS Corp.
800 Maude Ave.
Mountain View, CA 94043
(415) 964-2115

Size
18¾ by 11½ by 16½ inches without trays; 28½ inches deep with both trays in place; 60 pounds

Features
Diablo 630 and HP LaserJet graphics commands and line-printer emulation; manual or cassette feed; multiple fonts; landscape or portrait orientation; combined drum/toner cartridge; text amplification and horizontal expansion; 100-sheet tray; prints 150-dpi full-page graphics and 300-dpi half-page graphics

Options
Additional font cartridge: $300

Documentation
140-page user's guide with pull-out reference card

Price
$3495

```
This is 10-pitch Courier on the QMS

This is 10-pitch Courier on the BDS

This is 10-pitch Courier on the Quadlaser

This is 10-pitch Courier on the Canon LBP-8
```

Letter-quality typeface as rendered by the four laser printers.

Canon's documentation is thorough but not well organized, and it is definitely not sufficient to allow a computer novice to select multiple fonts from within a word processing document.

The BDS 630/8-E

The BDS Model 630/8-E, as its name implies, emulates the Diablo 630 daisy-wheel printer. [Editor's note: *The Model 630/8-E is an enhanced replacement unit for the original 630/8, which I used for this review. The new model has greater memory (256K bytes as opposed to 64K) and two more emulation modes (Hewlett-Packard LaserJet graphics commands and a line-printer mode of 66 lines per page with preset margins). The price of the enhanced unit is the same as that of the original, discontinued model: $3495.*]

One interesting feature of the Model 630/8-E is graphics amplification, which permits graphic or text enlargements of up to 800 percent. A similar feature allows

QMS Kiss

Type
Laser printer

Company
QMS Inc.
One Magnum Pass
Mobile, AL 36618
(205) 633-4300

Size
18¾ by 11½ by 16½ inches without trays; 28½ inches deep with both trays in place; 60 pounds

Features
Diablo 630, Qume Sprint, and Epson FX-80 emulation; advanced printing-command set; manual or cassette feed; 9 to 12 resident fonts, depending on emulation; landscape or portrait orientation; combined drum/toner cartridge; 1.25 megabytes of memory; downloadable fonts; Epson, Diablo, Qume, and IBM PC screen graphics; keypad/LED display for manual mode-select and status; full-page graphics at Epson single-density; ¾-page graphics at Epson double-density or high-resolution; 100-sheet tray

Options
Downloadable font disks ($199 each); PopSet software printer utility ($59); software tutorial

Documentation
User's guide, 330 pages

Price
$1995

QuadLaser

Type
Laser printer

Company
Quadram
One Quad Way
Norcross, GA 30093
(404) 923-6666

Size
20¾ by 13 by 16½ inches without tray; 14½ inches high with collection tray and 23¼ inches deep with paper tray; 82 pounds

Features
Qume Sprint 5 and Epson FX-80 emulation; custom printer driver; downloadable emulation software for HP LaserJet; manual or cassette feed; eight landscape and portrait fonts; 2 megabytes of memory; two-component toner and belt; automatic paper collation; QLX printer-control software; QuadFont font-creation/-modification software; 250-sheet tray; prints 300-dpi full-page graphics; printing speed of 8 pages per minute; downloadable font disks with 72 fonts

Documentation
Operator's manual, 158 pages

Price
$4495

horizontal expansion or compression of text from 70 to 160 percent of the original.

The graphics amplification feature permits printing headlines and signs or other documents in which the amplification can serve as an approximation of larger fonts. However, because the amplification uses the original bit-mapped image of a character, the text tends to break up as it is enlarged, with "jaggies" appearing in the diagonal lines. The greater the enlargement, the worse the jaggies, putting a practical limit on the use of the amplification feature.

The Model 630/8-E comes with 16 fonts, including various styles of Courier in 10 and 12 cpi and the IBM extended graphics character set, also in 10 and 12 cpi. An optional $300 font cartridge adds 16.7-cpi Gothic in portrait and landscape modes, Prestige Elite in portrait and landscape, and a scientific 12-cpi portrait font. According to a BDS spokesman, the company plans to introduce additional font cartridges approximating the popular Roman and Helvetica typefaces in various sizes from 6 points up to 18 or 24 points.

You select fonts manually using a control panel on the printer or through commands sent from the host computer along with the text. The BDS user's guide provides step-by-step instructions for using the printer with WordStar. The instructions also include a way to program the IBM PC or PC-compatible function keys so you can use them to change print modes.

The documentation also includes a pull-out reference card that summarizes all the printer's features, functions, controls, and error codes; none of the other printers reviewed offers this handy reference. Overall, the user's guide was straightforward and useful, though fairly brief.

The QMS Kiss

At $1995, the QMS Kiss is the least expensive of the four printers. It is also the most versatile in terms of its emulation modes. You can set up the printer to emulate a Diablo 630, several Qume Sprint daisy-wheel printers, and the Epson FX-80. The printer also recognizes an elaborate set of advanced printing commands peculiar to the QMS line of laser printers. One especially useful command lets you redefine the printer's character-translation table. For instance, if your word processor cannot handle Escape characters but you need them as part of a printer command, you can tell the printer to interpret the tilde or some other character as an Escape character.

The QMS Kiss has nine resident fonts; at any given time one font may be active for portrait printing and another may be active for landscape printing. You can select these fonts and the other parameters (e.g., printer emulation, mode characteristics, paper size and source, and copy count) through software commands or via the printer's control panel.

The portrait (vertical page orientation) fonts that are resident in the QMS Kiss are Epson Compressed, Epson Elite, Epson Pica, 16-point Q-Format, 10-cpi Courier, 12-cpi Prestige Elite, and 12-cpi Prestige Elite Italic. Two landscape fonts are resident as well: 5-point Q-Format and 10-cpi Courier.

Unlike the other Canon-based machines, the QMS Kiss does not accept font cartridges. Instead, you must download fonts into the printer's 78.5K-byte download-font memory. Currently, 16 font disks ($199 each) are available; each includes at least 10 different fonts.

The QMS Kiss has 128K bytes of memory for holding commands, text, and graphics, and it has 8K bytes for an input buffer. QMS offers an optional memory-resident software program for IBM PCs and compatibles that simplifies the printer setup process immensely. The program, called PopSet, lets you set up the printer via pop-up menus activated by the Alt-PrtSc sequence. PopSet costs $59 and is highly recommended.

QMS recently introduced a couple of more advanced printers, the Big Kiss and the Big Kiss Model 2, which offer font-cartridge capability, expanded memory, and other features. Prices of these two are $2995 and $4495, respectively.

The Quadram QuadLaser

This printer differs from the other three on several counts. The $4495 unit is based on the Ricoh engine rather than the Canon engine. Instead of the single toner-plus-photo-drum cartridge used in the Canon-engine printers, the QuadLaser uses separate cartridges for its toner and photoconductive belt. As a result, you don't

continued

need to discard a functional photo drum just because your toner is expended, as with the Canon-engine printers. Instead, you simply replace the toner cartridge.

Another difference between the two types of systems is in the paper flow through the printer. Canon-engine printers output a stack of pages in reverse order. The output of the Ricoh-engine machines is sorted properly from the first to the last page because the paper emerges face-down into the holder.

The QuadLaser has several features that go beyond simple convenience. The unit has built-in emulation of the Qume Sprint 5 and the Epson FX-80, as well as its own internal set of codes. Finally, the QuadLaser comes with downloadable software that enables it to emulate the HP LaserJet; users with advanced programming experience can write their own software to emulate almost any other printer protocol, subject to memory limitations.

Two fonts are resident in the QuadLaser: 10-point Courier and 10-point Courier Bold. Disks containing 72 other fonts for downloading into the printer are included with the unit.

The QuadLaser comes with 2 megabytes of memory, which is broken up as follows: 1 megabyte for bit-map graphics, 512K bytes for font emulation; and 512K as an input buffer. The unit also comes with a printer utility called QLX (QuadLaser executive). The IBM PC–compatible program lets you select printer emulation, fonts, page orientation, and page margins and dimensions.

Quadram also provides a font-design program called QuadFont with the QuadLaser. With it you create your own bit-mapped font or modify one of the existing fonts to your liking.

Performance

I ran the standard BYTE benchmarks for dot-matrix and daisy-wheel printers and printed a large file to measure the machines' throughput (see table 1).

Like copiers, laser printers take some time to warm up when you first turn them on. The Canon-engine machines all took just over one minute to get ready for printing. (Note: The additional 20 seconds for the QMS Kiss includes the time it takes to print a power-on status page at the end of its warm-up.) The QuadLaser was just a bit faster with its 50-second start-up time, but the difference is not really noticeable in a work environment. In a typical office, a laser printer is turned on in the morning and left running all day.

For the single-page character-speed benchmark, I used a BASIC program to time how long each printer took to produce a page containing 50 lines of 80 capital *A*s. Although the times were all close, the Model 630/8-E proved to be the fastest at 19.74 seconds. It was followed by the QMS Kiss (20.31 seconds), the QuadLaser (21.02 seconds), and finally the Canon LBP-8 (23.15 seconds). For all the benchmarks, all the printers were emulating a Diablo printer except the QuadLaser, which was emulating the Qume Sprint printer.

It is not accurate or fair to benchmark a laser printer on just a single printed page, however. A considerable amount of time is required at the beginning of each print run due to font-initialization requirements. For that reason, I timed the printers on some multipage jobs.

I ran the standard BYTE Shannon test, but instead of printing just 573 characters, I copied the test characters repeatedly until I had a 40K-byte test file and printed it using WordStar version 3.3. This time the QMS Kiss was the fastest, taking 4 minutes and 20 seconds to print the file's 12 pages.

Finally, I put together a text file that yielded 62 pages of single-spaced copy. It was made up of Chapter V, Section 21 of Strunk and White's *The Elements of Style* (third edition), repeated 25 times and was about 200K bytes long. The QuadLaser won this contest at 8 minutes and 29 seconds. A close second was posted by the QMS Kiss, which took 8 minutes and 53 seconds. These minor differences in speed are not significant, depending on buffer size and the resulting interaction with the host computer's software.

The maximum page-printing rate of all four printers, based on the print engine used, is eight pages per minute. Printers do not actually achieve that speed because of the longer time it takes for printing the first page, as well as other software factors.

One final general note about performance. All four printers worked out of the box with no coddling. Over 1500 sheets of letter-size paper went through these printers during the course of this review without a single paper jam. I only wish that my own dot-matrix printer could claim as much reliability and functionality.

For sheer value, the QMS Kiss stands out as the obvious winner. It costs just $1995 and offers a good variety of emulations, ample memory, a wide selection of resident fonts, and the availability of downloaded fonts. However, a need for special applications could point you toward one of the other printers. For instance, your needs might find a perfect match in the text-amplification feature of the BDS Model 630/8-E, the ISO-command support of the Canon LBP-8, or the automatic paper sorting, large memory, and host computer software included with the Quadram QuadLaser. ■

Arthur Little (2 Juniper Dr., Amherst, NH 03031) is a senior technical writer at Charles River Data Systems.

Table 1: *Benchmark results. Single-page times are in seconds; all other times are in minutes:seconds.*

Warm-up time with room temperature about 75° Fahrenheit	
LBP-8	1:18
Model 630/8-E	1:17
QMS Kiss	1:38
QuadLaser	0:50

Single-page time	
LBP-8	23.15
Model 630/8-E	19.74
QMS Kiss	20.31
QuadLaser	21.02

40K-byte Shannon text time	
LBP-8	4:31
Model 630/8-E	6:25
QMS Kiss	4:20
QuadLaser	4:37

200K-byte text file time	62 pages	Pages per minute
LBP-8	11:30	5.4
Model 630/8-E	20:37	3.0
QMS Kiss	8:53	7.0
QuadLaser	8:29	7.3

Warm-up time measures how long each printer takes to get ready to begin printing after being off for an hour. Single-page time measures how long it takes each printer to print a single page made up of 50 lines, each containing 80 *A*s. The 40K-byte Shannon test measures how long it takes each printer to output a file composed of the standard Shannon text repeated multiple times, which approximates average English frequency of characters. The 200K-byte text-file test measures how fast each printer outputs a 62-page document. Pages per minute is an average based on the number of pages printed divided by the total time required. The QuadLaser unit used for this review had less built-in memory and fewer fonts than the now-standard configuration; the BDS printer used was a non-enhanced version with less memory and only Diablo 630 emulation plus ISO code support.

EGAWONDER™

Any Software. Any Monitor. Any Time.[1]



Any Software on an EGA Monitor



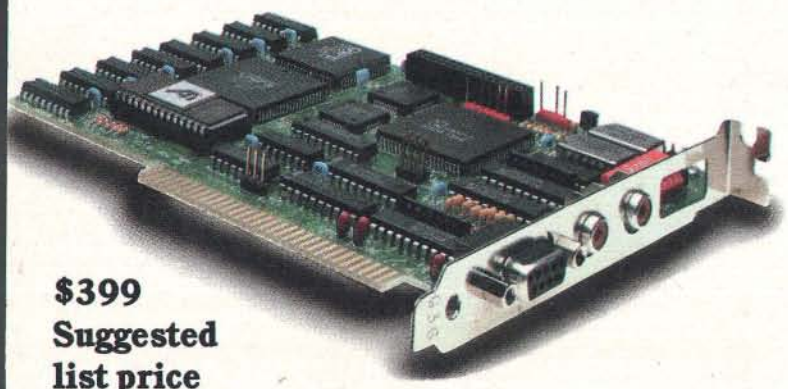
Any Software on a TTL Monochrome Monitor (or Compaq Portable)[2]



Any Software on an RGB Color Monitor[3] (or Composite, IBM Portable)

Upgrade to EGA without an EGA Monitor
The unique **ATI EGA WONDER** allows upgrade to the new EGA graphics standard without the purchase of an expensive EGA monitor. **EGA WONDER** runs EGA, CGA, MDA, Hercules and 132 column software on EGA Color, RGB Color, TTL Monochrome and Composite monitors. Extremely flexible, **EGA WONDER** maintains downward compatibility to both existing software and existing monitors. On the internal monitor of a Compaq PC Portable, **EGA WONDER** displays EGA, CGA, MDA and Hercules software via an optional expansion module.[2] For EGA monitor users, the **ATI EGA WONDER** improves the display of CGA software by producing high resolution 8×14 text and double scanned graphics. Old CGA software is now displayed with EGA quality. Completely compatible to IBM's EGA, **ATI's EGA WONDER** performs smooth scrolling, pixel panning and windowing. No memory modules are required because 256K of video memory is a standard feature. **EGA WONDER** is the only card able to display EGA software on the internal monitor of both the IBM PC Portable and the Compaq PC Portable. **EGA WONDER** provides an NTSC Composite signal for interface to a Polaroid Palette.

SoftSense Automatic Mode Switching
User friendly and easy to use, the **ATI EGA WONDER** has built-in SoftSense Automatic Mode Switching. It is actually able to sense and automatically switch between EGA and CGA color modes or between EGA, MDA and Hercules monochrome modes. The **ATI EGA WONDER** is compatible at the hardware level to the IBM Enhanced Graphics Adapter, the IBM Color/Graphics Adapter, the IBM Monochrome Display Adapter and the Hercules Graphics Card to minimize software incompatibilities.



$399 Suggested list price

EGA WONDER is now available from all major computer stores, call us today at **(416) 477-8804** for more information.

ATI® TECHNOLOGIES INC.

Technology you can Trust.

ATI Technologies Inc., 450 Esna Park Dr., Markham, Ontario, Canada L3R 1H5. TLX. 06-966640.

Trademarks IBM PC Portable – EGA CGA MDA – International Business Machines – Compaq – Compaq Computer Corporation – Hercules – Hercules Computer Technology – Polaroid Palette – Polaroid Corporation.

1. Any Software, Any Monitor, Any Time applies to IBM graphics, standards, monitors, software.
2. Optional Compaq Expansion Module (no 132 Columns) Suggested list price $99.
3. EGA, MDA, Hercules software displayed via interlacing. Flickering effect of interlacing reduced with purchase of anti-glare screen filter.

QUALITY: YESTERDAY, TODAY AND TOMORROW — PC INNOVATIONS

PIC AT 1800 + $995.00
NEC APC IV...CALL US

- 512K RAM Expands to 1MB
- 33% Faster Than IBM AT
- 1.2MB Floppy Drive
- 8/6 MHZ CPU 80286-8
- USA BIOS Fully Compatible
- Clock/Calendar W/Battery
- Hard Disk/Floppy Controller
- AT Style Keyboard
- 195 Watt Power Supply
- 48 Hour Burn In
- Full Documentation
- Includes Setup Software
- One Year Limited Warranty

Made in U.S.A. Enhanced Keyboard Available
10 MHZ Systems Available

PIC YOUR MONITORS
NEC Multisync $569
PIC EGA $429
PIC CGA $309

PIC YOUR BOARDS
Everex EGA..... $229
PIC EGA $199
PIC Monographics $95
AT multifunction
Up to 2MB $169

PIC COMMUNICATIONS
Everex 1200 INT..... $119
Everex 2400 INT..... $229
US Robotics 1200 INT..... $109

PIC YOUR PRINTERS
Epson LQ 1000 ..... $739
EPSON EX1000 ..... $569
NEC P5XL $995
Toshiba 321 ..... $525



10 Hughes St., Suite A-200
Irvine, CA 92718
(714) 768-8130

PC INNOVATIONS

ESTABLISHED SINCE 1980

1421 East Goldsmith
Plymouth, MI 48170
(313) 451-0664

PC INNOVATIONS

Photograph by David Vanzentan • 714-859-0444 • Graphics by V. Gott & Associates • 714-859-4014

PC Scheme: A Lexical LISP

William G. Wong

A powerful tool for learning programming style and semantics

PC Scheme version 2.0 from Texas Instruments is a low-cost ($95) implementation of Scheme that supports the DOS file system, windows, and graphics. It runs under PC-DOS and MS-DOS 2.0 or later and requires either dual disk drives or one floppy disk drive and a hard disk. The package is self-contained with an EMACS-style editor, EDWIN, which is customized for LISP, and a structure editor, EDIT. While PC Scheme requires a minimum of 320K bytes of memory, you must have 512K to use EDWIN. Three versions of PC Scheme are included with the system for running in conventional, expanded, or extended memory. The expanded and extended versions can address up to 2 megabytes of memory.

Scheme is a dialect of LISP developed by a team led by Gerald Jay Sussman and Guy Lewis Steele Jr. at MIT for experimentation with programming semantics and style. It is implemented as an incremental, optimizing p-code compiler suitable for developing applications for distribution, although not as stand-alone executable files.

A unique feature of Scheme is the lexically scoped variable definitions that give it a block structure similar to that found in C and Pascal. Traditionally, variables in LISP have had dynamic scope, meaning that their values are determined by the environment in force when the procedure requiring the variable is called. With lexical scoping, the value of a variable is determined by its definition environment. In Scheme, lexical scoping of variables is the default, but you can specify dynamic variable bindings. Another feature unique to Scheme is that every object is *first class*. This means that all objects can be passed as arguments and returned as results from procedures. PC Scheme also has a continuation-style execution environment, which I will describe later.

Tail Recursion

Scheme's lexical-scoping mechanism allows efficient compile-time optimization of tail-recursive functions. Tail recursion is used in listing 1. The function length returns the size of a LISP list. The let function defines find_length as a local variable that is a function. The find_length function call within the find_length definition is tail-recursive because the value it returns is also the value of the initial find_length function call. There is no need to consume stack space by making the inner find_length into a normal function call. Instead, this can be viewed as a GOTO that changes the parameters being used. This is similar to a loop statement in other languages but much more general.

This form of GOTO-like behavior is called a continuation-style environment. A continuation is a function that takes one argument and contains the information necessary to continue computation at a particular point. Each function can be viewed as taking a continuation as an implicit parameter. The continuation is called with the result of the last expression in a function definition. When evaluating a function's parameter, the continuation the function was called with is saved, and a new continuation is passed to each expression evaluation so that the parameter value can be obtained. For example, the (add1 size) function is passed as a continuation that uses the result as a parameter to the subsequent find_length call. The latter is performed not with a new continuation, but with one passed to the initial find_length call.

The use of continuations is useful in explaining how tail-recursion optimization works and how recursive function definitions can actually be compiled into interactive code. But PC Scheme actually makes the continuation accessible to the programmer via the call-with-current-continuation, or call/cc. The call/cc expression is a function of one argument, which in turn is also a function of one argument and looks like this:

```
(call/cc (lambda (x) exp))
```

The lambda expression is a function whose argument is bound to x. The exp expression is the code body for the lambda function. If the continuation, x, is encountered with some value during the evaluation of exp, then this value will be returned as the result of the entire call/cc function, and execution will continue at the point where the call/cc function was invoked. For example,

```
(call/cc (lambda (x) (+ (x 4) 5)))
```

The result of the call/cc function is 4, and the intervening + function is never performed because the x function invocation goes directly back to the point where call/cc was invoked.

This is essentially a LISP-style catch/throw function, where the catch function is similar to call/cc and throw is similar to the x parameter. However, the PC Scheme approach uses a named variable instead of a tag. The simplest use of continuations is as escape procedures in exception handlers, but you can also use them for implementing event simulation, nonblind backtracking, multiprocessing, and coroutines.

PC Scheme's use of lexical scoping provides fast access to function parameters and allows efficient implementation of closures. A closure is a function where all local variables are kept with respect to the function. For example,

```
(define (addx x) (lambda (y) (+ x y)))
```

continued

William G. Wong is president of Logic Fusion and a developer of systems and applications software. He can be contacted at Logic Fusion Inc., 1333 Moon Dr., Yardley, PA 19067.

← Inquiry 61

PC Scheme (version 2.0)

Type
LISP compiler and development environment

Company
Texas Instruments
P.O. Box 655012
Mail Station 57
Dallas, TX 75265
(800) 527-3500

Format
Two 5¼-inch floppy disks

Computer
IBM PC, XT, AT, or compatible (320K-byte minimum); two floppy disk drives or one floppy disk drive and one hard disk drive

Software
PC-/MS-DOS 2.0 or higher

Documentation
113-page user's guide
265-page language reference manual

Price
$95

is a function that returns a function that has a local variable of x. The function takes one parameter, y. Each invocation of addx creates a new closure with a corresponding x value. The (addx 5) and (addx 10) statements produce closures where x has a value of 5 and 10, respectively.

The idea of a closure is extremely powerful, and PC Scheme uses this idea in a number of areas. Some typical uses include comparison functions with a specified accuracy, generator functions (random numbers), and streams.

Data Types

PC Scheme provides the data types found in most LISP implementations. This includes 15-bit signed integers, variable-precision integers with up to 9520 decimal digits, IEEE floating-point numbers, character strings of up to 16K bytes, vectors with up to 10,921 elements, and LISP-style lists.

PC Scheme supports numbers with a full complement of functions including trigonometric, exponential, and useful mathematical functions such as greatest common denominator (gcd) and least common denominator (lcd). You can manipulate strings using functions as complex as substring-move-left! and substring-move-right!, in addition to substring-find-previous-char-in-set. The functions are sufficient to allow implementation of an EMACS-style text editor in PC Scheme.

I/O Support

PC Scheme supports text files with sequential-file access. Binary-file access is available by reading a character at a time. One serious limitation is that the package does not provide random-file access.

PC Scheme supports multiple character-oriented windows. Scrolling is automatic, and you can use pop-up windows as an alternative to regular windows. The application must control overlapping windows. Graphic functions are cursor-oriented; for example, draw-line-to takes two parameters, x and y, where the line is drawn from the current graphics cursor to the new point. This new point is the new value of the graphics cursor. The graphic functions access the entire screen directly, independent of the windowing scheme.

System Interface

You can interface PC Scheme programs to DOS and other programs using the dos-call procedure or the sw-int facility. The dos-call procedure lets you call other programs with a .COM or .EXE extension. Procedures are also provided for deleting, renaming, or copying files and getting a directory or size of a file. You can call memory-resident assembly language or Lattice C functions from PC Scheme by installing them as an interrupt service routine and then invoking the interrupt with the sw-int function.

The two methods provided for interfacing PC Scheme to other languages are not the best. The dos-call procedure would be inappropriate for calling a function that you want to use repetitively because it is slow and takes a lot of memory. Using the sw-int function might be good for repetitive functions, but installing a function as memory-resident is complicated. It would be much better if PC Scheme could produce object files that could then be linked to object files compiled with other languages.

Object-oriented Programming

PC Scheme supports an object-oriented programming system similar to the LOOPS and Flavors system found on LISP machines. The PC Scheme system is called the Scheme Object-Oriented Programming System, or SCOOPS.

SCOOPS supports multiple and dynamic inheritance. This allows you to build an object-class definition from a set of other objects. For example, a boat object could be composed of a moveable object with a location, direction, speed, and weight plus an object that can carry other objects with attributes such as capacity and current contents. SCOOPS does not support a hierarchical class system, as the one in Smalltalk.

Objects are associated with a class, and each class may contain variables common to all objects of the class. The class is also the common repository for *methods*, or functions, that can be invoked through an object. Objects may contain variables that are distinct for each object. A method is invoked using the send function, as in

```
(send boat-object set-speed 100)
```

The actual process used by send to invoke the method corresponding to set-speed is hidden so that the compiler can make optimizations when possible.

Multitasking

PC Scheme supports multitasking through the use of engines and continuations. An engine is an object that can be set up to run for a specified number of ticks. In PC Scheme, the length of a tick depends on the system clock. An engine is created using the make-engine function, which takes a function with no parameters. The result is a function, or closure, that takes three parameters: the number of ticks, a success-continuation function, and a failure-continuation function.

You run an engine by calling the function with the three parameters. The engine

Listing 1: *This recursive implementation of a function to find the length of a list causes no net growth of the stack because the PC Scheme compiler optimizes the tail-recursive call to* find_length.

```
(define (length list)
        (let ((find_length
                (lambda (list size)
                        (if (atom? list)
                            size
                            (find_length (cdr  list)
                                         (add1 size))))))
          (find_length list 0) ))
```

executes its internal function for the number of ticks specified or until the engine-return function is executed. You invoke the failure-continuation function with a single parameter, which is a new engine with the same internal function as the initial engine. You can use this again and again until the engine-return function is finally used. In this case, the success-continuation function is invoked.

The success-continuation function takes two parameters: the parameter to the engine-return function that caused the success-continuation function to be invoked and the number of ticks remaining. This setup allows a multitasking executive to service system requests from processes that are run as engines.

The continuation-passing approach to Scheme is important here because the stack does not continue to grow as each of the continuations is invoked. Instead, the execution process can be viewed as moving from a user process within an engine to the executive and then directly into another user process.

The approach allows you to build a time-slice multitasking system. In theory, real-time interrupts could be supported, but these have not been implemented. The actual details of the executive are left to the programmer. PC Scheme provides a number of support functions to assist in the implementation of such a system, but no examples are provided. Unfortunately, developing such a system may be beyond the interest or capability of many programmers unfamiliar with Scheme.

References to some good articles on the subject are in the documentation's bibliography, but many of them, such as ACM conference records, may be difficult to obtain. They also tend to be at a rather academic level. More suitable examples should have been provided with the package. Various examples would be appropriate because techniques to implement secure operating systems and various scheduling methods are difficult to work out from scratch. PC Scheme provides a great way to experiment with these techniques if you can figure out how to set them up.

Although it is a dialect of LISP, PC Scheme differs greatly from conventional LISP implementations. Using the system is the only good way to learn and appreciate all its facilities.

Editors and Debugger

PC Scheme comes with two editors: EDIT and EDWIN. EDIT is a command-driven structure editor that edits data structures in memory. It is useful for working with LISP lists directly, especially circular lists. Because this editor works on a tree comprised of pairs and atoms instead of strings or files of characters, it takes a bit of practice to become proficient with EDIT.

The EDWIN editor is a screen-based text editor patterned after EMACS with LISP-specific support. It uses some of the function keys and many control-key sequences. You can load and save text files as you can with conventional text editors. In addition, you can evaluate Scheme expressions directly from within the editor. EDWIN's response time is a bit slow on a PC XT. The editor could not display the characters as I typed them unless I typed very slowly. The response time is acceptable on a PC AT, however. Both editors are written in PC Scheme. However, their source code is not provided, so user modifications or enhancements are out of the question.

The debugging facilities give you flexibility in tracing procedures and setting both conditional and unconditional breakpoints. The debugger is invoked when a breakpoint or error is encountered. It allows single-character control-key functions that provide information about the current environment. You can examine and change variables and evaluation status.

A compiler debug flag is available that allows you to compile functions with enough information to let you view functions while debugging a program and determine what is going on. Setting the debug flag to true cancels some of the optimization; functions compiled using this mode operate three to four times slower. Also, because additional information is saved, the program may no longer fit in memory.

Documentation

PC Scheme comes with two manuals: a language reference manual and a user's guide. They are relatively complete and well organized with sufficient examples to allow you to use the system to a limited degree. Unfortunately, they are insufficient for learning about how to apply all the features found in PC Scheme.

The documentation includes tables organized by function, and the index and bibliography are invaluable. Function definitions are listed alphabetically. The documentation lists a number of system limits such as the maximum string size in bytes, but many other necessary pieces of information are left out. For example, there is no way to find out what the memory requirements are for lists or function invocations. These details are critical when applications become large in comparison to the amount of available memory.

The documentation recommends the book *Structure and Interpretation of Computer Programs* by Harold Abelson and Gerald Jay Sussman with Julie Sussman (MIT Press, 1985). This book should have been included as part of the package, as most people unfamiliar with Scheme will find PC Scheme confusing without it. This group includes most LISP programmers, except possibly those who have used full Common LISP or Scheme-like implementations.

Benchmarks

I tested PC Scheme using a number of simple benchmark procedures, each performed 5000 times (see table 1). The cons test takes a nil list and inserts nil as the first element. Integer addition and multiplication tests add and multiply 1 by 2. The floating-point addition and multiplication tests add and multiply 1.2 by

continued

Table 1: *A comparison of benchmarks performed on PC Scheme, Golden Common LISP, and Waltz LISP. Each test was run 5000 times. The Dummy NOP operation is simply a function call that returns a null value, which is used to calibrate the loop. All other times include the loop time as well. All times are in seconds.*

Test Name	PC Scheme 2.0	Golden Common LISP 1.01	Waltz LISP 5.01
Dummy NOP	7	15	16
cons test	11	18	18
Integer addition	11	18	19
Integer multiply	11	18	20
Floating-point addition	22	26	—
Floating-point multiplication	32	30	—
Global assignment	11	17	19
Local assignment	7	—	—
List indexing	234	26	36
Vector indexing	10	18	—
String indexing	10	18	23

234324.3. The global-assignment test assigns the list (1 2 3) to a variable. The local-assignment test, performed only for PC Scheme, defines a variable local to the function and assigns the list (1 2 3) to it. The list-, vector-, and string-indexing tests define a 128-element list, vector, and string, respectively, and access the 120th element.

I did not perform the file read and write functions because PC Scheme does not support a string-read function. For comparison, I also tested Golden Common LISP 1.01 and Waltz LISP 5.01. These two packages do not have lexical scoping, so the local-assignment test does not apply to them. Also, because they are interpreters, their tests should be expected to run slower than the compiled PC Scheme code. In most cases, however, the interpreters did not lag far behind PC Scheme, and in list-indexing they beat the compiler. Waltz LISP does not support floating-point numbers or vectors. (For more information on Waltz LISP, see my review of BYSO LISP and Waltz LISP in the July 1986 BYTE. [Editor's note: *Benchmark programs for PC Scheme, Waltz LISP, and Golden Common LISP are available on disk, in print, and on BIX. See the insert card following page 352 for details. Listings are also available on BYTEnet. See page 4.*]

Summary

PC Scheme is a good product with much potential and only a few deficiencies. The reading and compiling of programs was slow, as was the overall response of the screen editor, EDWIN. The latter might be improved with additional built-in functions or by optimizing some critical functions, but this is speculation since the source for EDWIN, which is supposed to be written with PC Scheme, is not provided. It would have proven to be a useful example of how to use PC Scheme.

The two areas that really need work are the file support and interfaces to other languages. File support needs to be enhanced, especially random-file access and binary-file support. The interface to other languages would be improved if PC Scheme could produce object files that could then be linked to object files compiled by other languages. Another much-needed addition is the generation of stand-alone executable files (.COM or .EXE).

PC Scheme is suitable as a learning tool and for a number of symbolic and graphic applications. However, it lacks major features such as random-file access, formatted output, record structures, and fixed-point arithmetic necessary for accounting or numeric processing. Sufficient enhancements could easily make it into a powerful general-purpose language. ■

Concurrent PC DOS

Wayne Rash Jr.

Digital Research first attempted to meet the needs of multitasking users with multi-user MP/M, and later with Concurrent CP/M. Now Concurrent PC DOS combines the capabilities of both these products in a system that runs multiple programs simultaneously and supports external terminals as well. Concurrent PC DOS runs software written for both MS-DOS and CP/M-86 in a menu-driven windowing operating environment that provides extensive on-line help.

Compatibility

Concurrent PC DOS version 5.0 ($395) runs on the IBM PC, PC AT, and close compatibles such as Compaq, AT&T, and Zenith computers. Digital Research provides a complete list of computers that Concurrent PC DOS supports.

Your system must have at least 256K bytes of memory (Digital Research recommends 512K bytes) and one double-sided floppy disk drive to run Concurrent PC DOS. (Two floppy disk drives or a floppy disk drive and a hard disk drive should be considered the practical minimum.) Concurrent PC DOS supports a color monitor if you have one.

Version 5.0 of Concurrent PC DOS also supports the Lotus/Intel/Microsoft Expanded Memory Specification (EMS) as well as the Enhanced Expanded Memory Specification supported by Ashton-Tate, Quadram, and AST Research. Concurrent PC DOS can use either of these memory-expansion systems to increase the amount of memory available to applications (both support 8 megabytes of RAM). This will allow you to run several large programs at the same time.

Because it is a large, flexible operating system that contains many utilities, Concurrent PC DOS takes up a lot of disk space (you will need a little more than 1 megabyte). Concurrent PC DOS comes on four 5¼-inch floppy disks and includes a Card File program, a text editor, a Printer Manager program, and the operating system support software.

Concurrent PC DOS supports all CP/M-86 software and most major MS-DOS software. There are some restrictions on the use of MS-DOS software, but most major programs including Lotus 1-2-3, WordStar, and dBASE III will run well. Digital Research provides a list of MS-DOS software that has been tested with Concurrent PC DOS, and it notes any special concerns involved with running it.

Installation

To install the software, floppy disk users need only press a key. The disk copying operations are handled via a single menu selection and use a program that identifies the disk format on the original disk and formats the target disk accordingly. Concurrent PC DOS handles MS-DOS– and CP/M-formatted disks with equal facility. The installation process requires only that you insert disks when directed.

Hard disk installation is also handled automatically. Digital Research makes things easy for the user by acknowledging the predominance of MS-DOS and finding ways to work within it. You can install Concurrent PC DOS in a subdirectory on your MS-DOS–formatted hard disk and run it from there. This allows you full access to all the MS-DOS directories and device drivers that do not exist for Concurrent PC DOS. For example, I was able to use the Xerox 6060 mouse with the Concurrent PC DOS File Manager.

During the installation process, Concurrent PC DOS creates a subdirectory called CON-DOS and then modifies your AUTOEXEC file so that you can run either MS-DOS or Concurrent PC DOS. You can also boot automatically from Concurrent PC DOS or create a disk partition devoted to Concurrent PC DOS. If you choose to use a CP/M-formatted disk, you are forced to use the CP/M user levels instead of the more flexible hierarchical directory structure of MS-DOS.

Using the CP/M-formatted disk has one significant advantage, however. You are no longer restricted by the MS-DOS 32-megabyte limit on disk size. The user's manual does not specify the maximum disk size that is supported, although earlier versions of the system were said to support any size disks available. Concurrent PC DOS had no trouble with 40-megabyte drives.

Running Concurrent PC DOS

If Concurrent PC DOS is on your hard disk subdirectory, you'll first become aware of it when MS-DOS starts running the AUTOEXEC file. You will be asked if you want to run Concurrent PC DOS. If you type Y, a message appears that says the system is loading. Next you see a sign-on screen that invites you to press F1 to see a menu or Esc to get the system prompt.

If you press Esc, the familiar C> prompt appears. Many of the commands

from MS-DOS perform their familiar functions, as do most of the CP/M-86 commands. In many instances the commands overlap functions. You can copy files using either the MS-DOS COPY command or the PIP command from CP/M. In both cases the commands retain their normal syntax.

Concurrent PC DOS runs programs simultaneously by using virtual consoles. You can use each of these consoles just as you would a single-user console, and you can switch from one to another. To switch consoles, you press the Ctrl key followed by a number (1 through 4) on the keypad. You can, if you wish, create windows for one or more consoles that allow you to see more than one program running at a time.

Once you start a program, you can switch to another virtual console while that program runs. There are some restrictions on this; for instance, some MS-DOS programs, such as dBASE III and Lotus 1-2-3, ignore the operating system and write information directly on the screen. When this happens you can get screen output from a console that is switched out. Concurrent PC DOS allows you to suspend operation of an MS-DOS program unless its console is selected.

File Manager

If you prefer to use menus, the File Manager allows you to perform all system functions by selecting a command with a highlighted cursor and pressing Enter. (I used the optical mouse on the Xerox 6060.)

If you run a program from the File Manager, Concurrent PC DOS returns to it when the program finishes running. Any command that makes reference to a file allows you to indicate your file choice by moving a marker to the one you select and pressing Enter. If you want to type a text file, for example, you use the arrow keys or a mouse to move the cursor to the TYPE command, and press Enter. As soon as you do this, you will see an arrow pointing to directory entries on the screen. Again you move this arrow around with the arrow keys or the mouse until it points to the file you want, and press Enter. The file is printed on your screen, and then you are returned to the File Manager. You can also type in a command, if you wish.

Below the screen containing the directory information is a line that displays Help messages, and beneath that is a menu that shows the assignments of the function keys. You can reassign the function keys if you choose to do so.

Status Line

With an operating system that performs as many functions simultaneously as Concurrent PC DOS, it's very important that you know what is going on at any time. For this reason, Concurrent PC DOS includes a status line at the bottom of the screen that tells the name of any programs that are running, the printer assigned, any disk drives that are in use, and the time. The time does not make use of the clock/calendar installed in some computers. Concurrent PC DOS does not keep very good time in all cases. On the Xerox 6060, the clock gained about two minutes per hour, while on a Zenith Z-148, the time was accurate.

If you are running more than one program at a time with Concurrent PC DOS, you can watch the status line change as programs are loaded or when execution finishes. This alerts you when you need to change virtual consoles or perform other steps in a process. The status line also shows the progress of a program being executed automatically using a batch or submit file.

Running MS-DOS Programs

There are a number of restrictions on the use of MS-DOS programs in Concurrent PC DOS. Most of these restrictions revolve around screen use by the software.

Another consideration is the use of memory. Concurrent PC DOS allocates memory automatically for CP/M-86 programs, but MS-DOS programs react differently. Sometimes a program can grab all the available memory even if it is not going to use it. Therefore, Concurrent PC DOS allows you to designate a specific amount of memory for MS-DOS applications.

Most MS-DOS applications run well, but a number of programs, most of them system utilities, do not. These include FORMAT and CHKDSK. Sometimes nothing happens if you try to execute one of these programs, and at other times a program can lock up a console, requiring a reset of the computer before you can use that console again. Fortunately, the other consoles usually are not locked, so you can save other information before you perform the reset.

Multiuser Operation

Concurrent PC DOS's value really shows when you realize how easy and inexpensive it is to install multiuser operations. If your computer has a serial port, all you need to set up a multiuser system is either an ASCII terminal and a cable or another computer running a terminal emulation program.

A number of restrictions apply to using a serial terminal, since most single-user applications aren't written with this in mind. Nevertheless, many programs will run very nicely, including the MS-DOS and CP/M-86 versions of dBASE II and some versions of WordStar.

Although the multiuser mode works quite well, you may have a problem getting it started, especially if you're using a computer running in terminal emulation. The Concurrent PC DOS manual provides relatively little information on the multiuser mode or the proper hardware connections.

On the other hand, the software that sets the serial port parameters is well explained and easy to use. The Setport program sets up the communications details, and the Setup program configures the serial ports for multiuser terminals or printers. Both programs make use of menus and function keys.

Once everything is set up, using your terminal is like using the host computer. The only time you know that you're in a multiuser environment is when both users try to access the disk drive at the same time; there will be a brief delay for the user who tries last. Otherwise the system shows little effect from splitting itself between users. You should note, however, that I reviewed Concurrent PC DOS using an 8-MHz Xerox 6060 with a hard disk and an IBM PC AT. System response could vary with other machines.

continued

Concurrent PC DOS version 5.0

Type
Multiuser multitasking operating system

Company
Digital Research Inc.
60 Garden Court
P. O. Box DRI
Monterey, CA 94942
(408) 649-3896

Format
Four 5¼-inch floppy disks

Computer
IBM PC, XT, AT, and many close compatibles

Necessary Hardware
One double-sided, double-density floppy disk drive and 256K bytes of RAM (512K recommended)

Documentation
250-page user's manual
150-page reference manual

Price
$395

Once you have the operating system communicating with your terminal, you must take care of a few other details. Any programs that you anticipate might be used in more than one window or by multiple users have to be set to read-only status. In addition, you must be careful to choose terminal control codes that both your computer and your terminal will understand. This may take some trial and error. Unfortunately, Concurrent PC DOS does not use the ANSI.SYS device driver in the same manner as MS-DOS, so you must find an alternative device driver.

Utilities and Applications

Several useful programs come with the operating system. Concurrent PC DOS also includes versions of most of the utility programs supplied with both CP/M and MS-DOS.

The DR Edix text editor allows you to edit and display text in any of four windows. It works well for writing programs, memos, and the like, and while it's not designed to replace a full-fledged word processor, it does provide full-screen editing, unlike MS-DOS EDLIN and CP/M ED.

The Card File program is designed to perform as an electronic Rolodex. It is set up to handle the same type of information that you would have on a telephone file, and it has space for comments. You can search for information by field, look through all the cards, and use the program to print mailing labels and index cards.

The Printer Manager is a necessity for a system that may have three users and multiple printers. This program puts printing jobs into a queue, assigns them to the proper printer as requested, and formats the text where necessary. You can run the Printer Manager from a menu, or you can enter the necessary information from the command line, making it easier to load the print queue using a batch file.

Documentation

For the most part the user's manual is very clear, has excellent illustrations, and is well indexed. Still, there are areas that can be improved. The discussion on terminal installation is probably the weakest. Discussions of multiuser operations are scattered throughout the manual. This information needs to be presented completely, and it should be collected in a single place. Technically inclined users would benefit from expanded explanations of printer installation and from information about how to write programs that take advantage of the capabilities of Concurrent PC DOS.

The Bottom Line

Many small businesses need to be able to share information but don't want to pay for additional computers or for a local area network to connect them. Provided that the software they need will work with Concurrent PC DOS, this can be a very good approach.

Still, this is not the answer for everyone, since there is some MS-DOS software that will not run under Concurrent PC DOS, such as Framework 1.0, dBASE III 1.0 (later versions work fine), and a few of The Norton Utilities. Even more software will not run in a console that is switched out or that is in a window, and still more will not run with a terminal. However, the software that does run performs well. I found no degradation of performance in running MS-DOS software with Concurrent PC DOS. In fact, Concurrent PC DOS was much faster than MS-DOS for some operations.

I recommend this product, but with some reservations. Like any multiuser or multitasking operating system, it is more complex and requires more skill to set up and use than a single-user system. On the other hand, if you have an application that requires multitasking access with multiple users (such as a two-line bulletin board), or if you need to find a way to stop waiting for your computer to finish a task before starting another one, this is an inexpensive and effective way to do it. [Editor's note: *If you intend to buy Concurrent PC DOS 5.0, check with Digital Research to make sure that any applications you use will work with it and to learn what fixes might be required for software that will not run as is.*] ■

Wayne Rash Jr. is a member of the professional staff of American Management Systems Inc. (1777 North Kent St., Arlington, VA 22209), where he consults with the federal government on microcomputers.

Wendin's Operating System Toolbox

Jason Levitt

Wendin's Operating System Toolbox (OST) consists of about 300 files containing C source code (85 percent) and assembly code (15 percent) that you can compile and link to create the kernel of your own personal operating system. This resides on top of MS-DOS and accepts most MS-DOS system calls. With the OST you can create the operating system best suited to your needs by coding a user interface, or shell, and linking it with the kernel. The bulk of the operating system, the kernel, is completely supplied for you in object and source form on two disks.

Wendin's kernel has an accessible system-call interface and is robust enough to support a wide variety of operating system services such as multitasking and pipes. Application programs designed in your newly created operating system environment can take advantage of Wendin's enhanced system services, which include multitasking, paged memory management, and concurrent I/O. If you don't want to code your own user interface, you can purchase either PCVMS or PCNX (each for $99) from Wendin. These are two operating systems created with the OST. PCVMS has a user interface similar to the one supplied with VAX/VMS systems, while PCNX has a UNIX-like interface.

What You'll Need

The OST is designed to be used with MS-DOS 2.0 or higher and an IBM PC, XT, AT, or a 100 percent compatible system. PCNX did not run on my IBM RT PC with a PC AT coprocessor card installed. A hard disk is necessary because the source code for the kernel unpacks to a megabyte of disk space, and you will need room for your C compiler and object modules. Memory restrictions are modest, even though the operating system will end up wholly memory-resident. For instance, PCVMS requires less than 256K bytes to run, and PCNX requires less than 384K bytes.

Since the kernel is written in C, you'll need a C compiler. Using the Microsoft C compiler version 3.0 will greatly simplify compilation since the kernel is also supplied in Microsoft object form. If you don't have Microsoft C, then you'll have to compile the entire kernel by hand. The C compiler you choose must contain a number of features explained in the OST documentation. The three most important features are: It must generate reentrant code, it must support a large memory model, and the stack-segment register must be allowed to change after load time. The Lattice C compiler is mentioned in the OST documentation as a possible

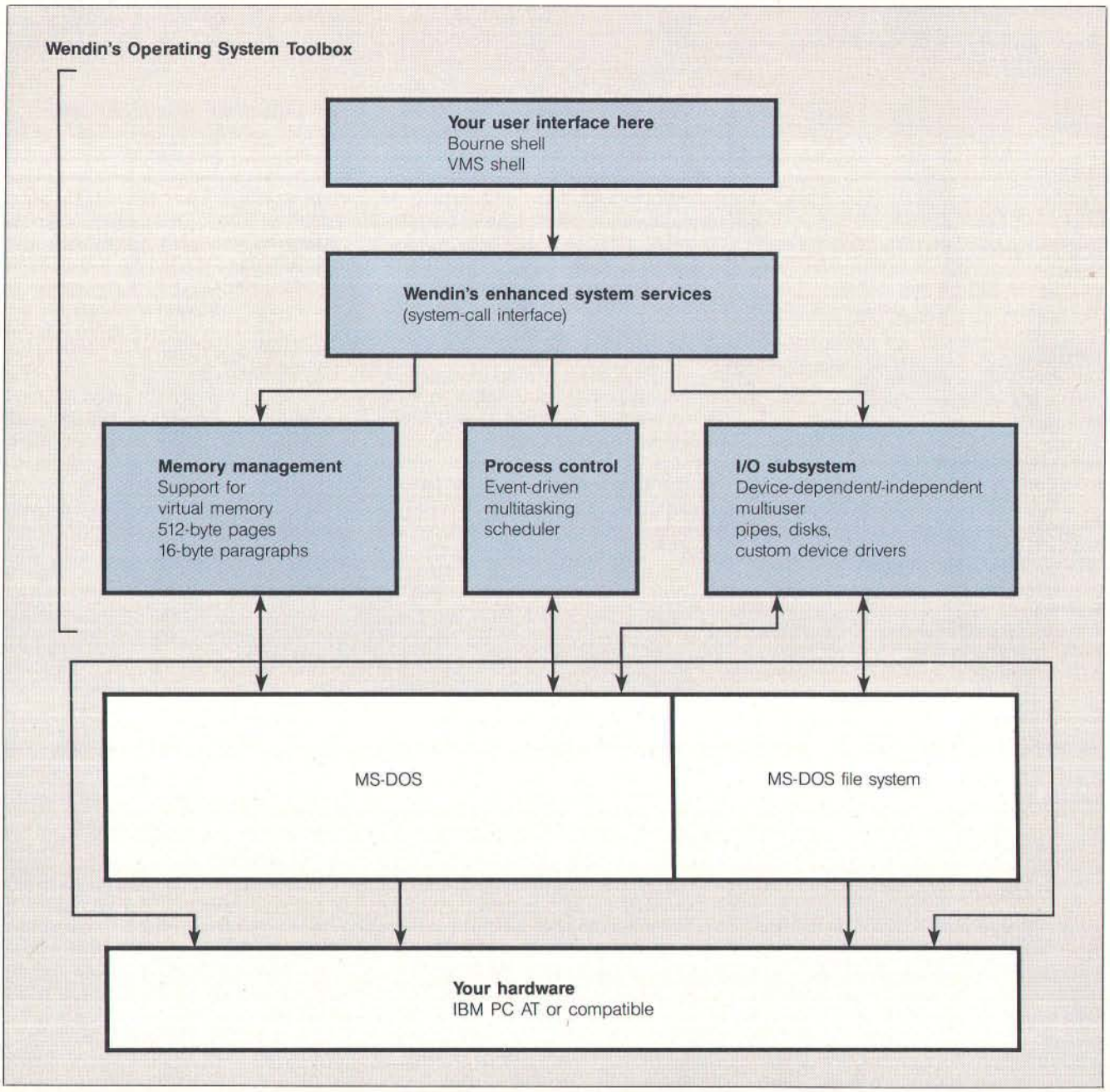


Figure 1: *An overview of a personal operating system built with Wendin's Operating System Toolbox. The Toolbox uses MS-DOS system calls to a great extent, but it also interacts directly with the hardware.*

alternative to Microsoft C 3.0.

You can code the user interface in any language. However, the language must somehow access the system calls provided by the kernel, and the object module will ultimately be linked with the kernel. If you want to avoid working with assembly code, the package comes with libraries for Turbo Pascal and Microsoft C. An advanced MS-DOS programmer could easily adapt other languages using the source code provided.

You'll also need an editor. The documentation suggests Wendin's XTC editor. For $99, this package gives you a thoroughly documented and reasonably fast text editor that supports multiple windows, a built-in macro language, and complete source code on disk. Being able to look at eight source files on the screen simultaneously in eight small windows is useful when you are dealing with the over 300 separate source files. I used it successfully without even opening the manual, since the on-line help was adequate. The editor lets you use a common subset of commands without having to deal with other features until you need them.

The Kernel

The OST is divided into three major components: process management, memory management, and the I/O subsystem. Each of these components is designed to add increased functionality to MS-DOS. Figure 1 illustrates the structure of an operating system built with the OST.

The OST process-management component allows the multitasking of processes by using a scheduler algorithm to queue processes that are attempting to run under DOS. The design of the event-driven

continued

Wendin's Operating System Toolbox version 1.08

Type
Operating system development package

Company
Wendin Inc.
P.O. Box 3888
Spokane, WA 99220
(509) 624-8088

Format
Two 5¼-inch disks; MS-/PC-DOS format

Computer
IBM PC, XT, AT, or 100 percent compatible with a hard disk (5 megabytes minimum)

Necessary Software
MS-DOS 2.0 or higher; C compiler; editor

Languages
Microsoft C version 3.0
Microsoft MASM version 3.0

Options

PCVMS operating system:	$99
PCNX operating system:	$99
XTC editor:	$99

Documentation
312-page user's manual

Price
$99

scheduler algorithm is based on the one used with the VAX/VMS operating system; each process in the queue has a current state assigned, and it waits until an appropriate system event modifies its status in the queue. Processes execute in one of four privilege modes, which are, in order of least to most privileged, User, Supervisor, Executive, and Kernel. Each mode has its own stack and, normally, processes executing in User mode do not have access to kernel data structures. However, without hardware protection this cannot be rigidly enforced. The multitasking works but, as might be expected on a system that isn't designed for multitasking applications, it is extremely slow. For instance, a small program running in the background causes a delay in echoing subsequently typed characters. In addition, the lack of hardware protection for memory on the 8086 makes it easy for a simple program to corrupt other processes waiting in the scheduler queue.

Memory management provides for the dynamic allocation and deletion of memory segments for individual processes in 512-byte or 16-byte blocks. Operating systems implemented on an IBM PC AT can take advantage of system calls that allow virtual memory management. IBM PCs swap entire processes in and out, since they have no hardware support for virtual memory management. All systems can lock pages into memory to support memory-mapped devices or other critical data that shouldn't be swapped or paged out.

The I/O subsystem supports device-independent and device-dependent I/O with terminals, disks, and pipes. The OST uses the MS-DOS disk device drivers and the MS-DOS file system for compatibility. Creating new device drivers is straightforward using Wendin's system calls. Concurrency of I/O operations by using software interrupts and queuing device requests allows processes to share devices. A multiuser configuration is achieved by hooking up one or two terminals, in addition to the console, to asynchronous communications ports on your IBM PC. I hooked two terminals up to my IBM PC XT running Wendin's PCNX, and I was pleased to see log-in prompts appear at both terminals and the console. I ran a different software package on each terminal simultaneously (a word processor, a database, and a game) without failure, although they ran rather slowly at both 4800 and 9600 (top speed) bits per second. The documentation cautions that certain programs that poll the communications ports directly (such as IBM's BASIC and BASICA interpreters) will crash the remote users. I, unfortunately, verified this behavior. The OST is indeed a multiuser operating system, but lack of hardware memory protection on the IBM PC makes each user vulnerable to the others.

The discussion above underscores the major drawback of the OST. The 8088 chip in the IBM PC does not support the virtual memory, multitasking, multiuser capabilities that Wendin provides in its software. The IBM PC AT supports these enhancements, but the OST does not take advantage of much of the 80286's functionality. Also, multitasking under DOS is a well-known kludge. Several software packages that I have seen allow multitasking, but DOS is a steadfastly single-threaded operating system, so multitasking is always achieved by handing processes to DOS one at a time and controlling how long DOS can execute each process.

The VAX/VMS operating system has influenced many of the minor design choices of the OST. In addition to the access modes and scheduler mentioned above, VMS users will recognize the authorized privileges that users may be granted, such as GROUP, BYPASS, ALLSPOOL, DETACH, WORLD, and the use of logical names for devices, like SYS$INPUT and SYS$ERROR.

The Enhanced System Services

The enhanced system services are the set of system calls provided by the OST. It is an appropriate name because many of the system calls are just filtered MS-DOS system calls in disguise. The enhanced version of the system call is well documented and allows access to the extra features in the OST. Both the operating system and application programs use enhanced system service calls. For instance, when you log onto PCNX, the Getty program creates a shell process for you using system service calls. As mentioned earlier, libraries containing these system services are included for Turbo Pascal and Microsoft C. Another alternative is to call the procedures directly using software interrupts (which is what the library routines do anyway).

The 80 or so system calls are documented in about 120 pages of the 312-page user's manual. About 30 of the system calls are for process control management, with the rest being almost evenly divided among device, memory, and file management, and a few additional calls for event-flag, logical-name, and time-conversion services. Each system-call description includes the calling format in high-level language and macro assembler format with argument description and return status.

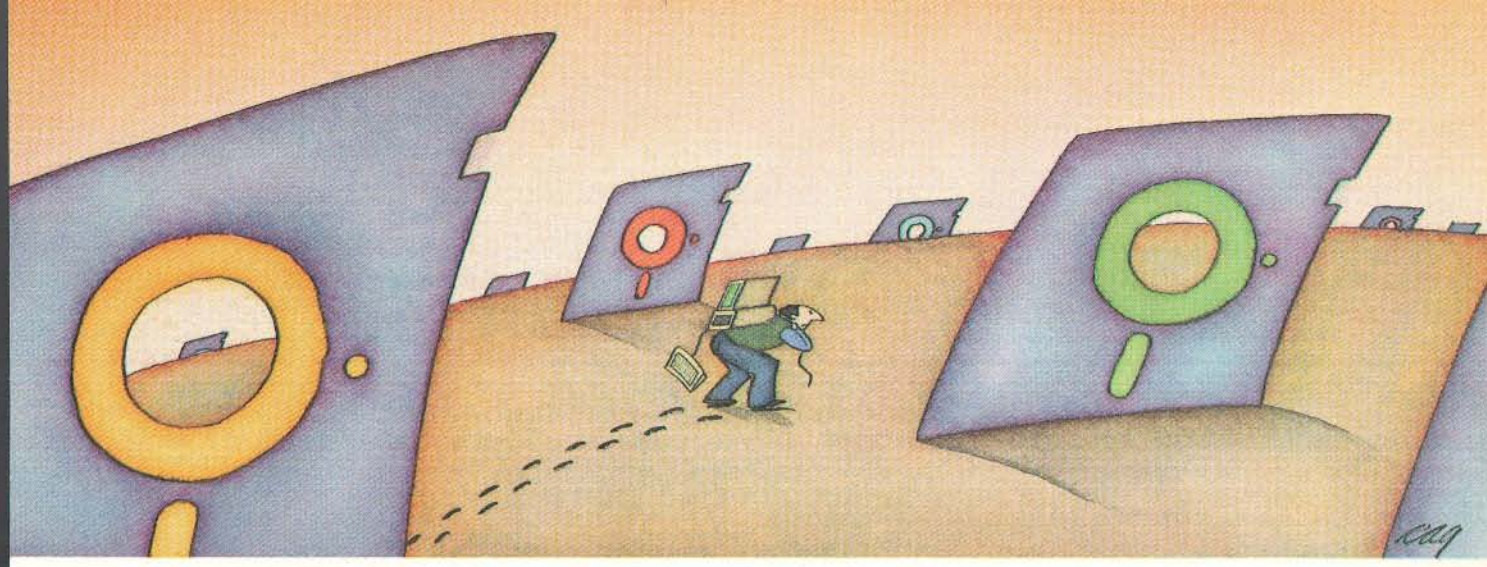
Applications

Wendin suggests three uses for the OST. You can code your own user interface with Wendin's enhanced system services and link it to the kernel supplied on the release disks. Wendin provides a sample user interface coded in C that you can use as the starting point for development. The sample interface simply displays a prompt and allows you to execute DOS programs with the added feature of a PS command to obtain the process status list from the kernel. The user interface development philosophy is to be careful and to add features to the example a little bit at a time because you can't trust a debugger running from a defective user interface.

Most MS-DOS programs (Multiplan, for instance) will execute properly under the OST. However, the OST discourages the use of MS-DOS calls that don't belong in a multiuser multitasking operating system. The documentation claims that all well-behaved DOS programs will run; programs that don't directly address the hardware should be fine.

The second application of the OST is as a back end for applications that require

continued



PROBLEM: There's just no easy way to move from one software program to another.

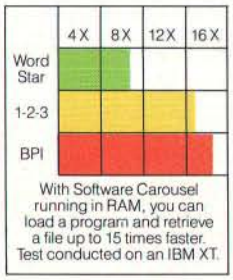
NOW FASTER, AND NOT COPY PROTECTED!

THE SOFTLOGIC SOLUTION: Software Carousel™

Now you can keep up to 10 programs loaded and ready to run.

Hard to believe, but some people are happy with just one kind of PC software. Well, this is not a product for them.

But if you're someone who depends on many packages, all the time—someone who'd use several programs at once if you could, well now you can. With Software Carousel.



With Software Carousel running in RAM, you can load a program and retrieve a file up to 15 times faster. Test conducted on an IBM XT.

Why call it "Software Carousel"?

In some ways, Software Carousel works like the slide projector you're used to. You load a handful of pictures, view one at a time, then quickly switch to another. A simple idea, with powerful possibilities for computing.

Here's how it works. When you start Software Carousel, just tell it how much memory you have, load your software and go to work.

Need to crunch numbers? Switch to your spreadsheet. Need your word processor? Don't bother saving your spreadsheet file. Just whip over to your document and do your work. Snap back to your spreadsheet, and it's just like you left it.

With up to ten different programs at your fingertips, you'll have instant access to your database, communications, spelling checker, spreadsheet, word processor, RAM resident utilities, languages, anything you like.

Reach deep into expanded memory.

This could be the best reason ever for owning an expanded memory card, like the Intel Above Board, AST RAMpage, or any card compatible with the L/I/M Extended Memory Standard.

Software Carousel puts programs into this "high-end" memory for temporary storage when they're not in use. And switches them back out when you want them. It's fast, efficient, and easy.

If you want, Software Carousel will even use your hard drive for swapping. Just allocate a portion for storage, and go to work.

Sidekick, Superkey and Ready. All at the same time.

You know what happens if you try loading two or more RAM resident utilities at once. You get crashed keyboards, frozen screens, all kinds of interference between programs fighting for control.

With Software Carousel, you can have as many accessories and utilities on-tap as you want. Just load different ones in different Carousel partitions. Since they can't see each other, they can't fight.

The easy way to maximize PC power.

With all this power, you might think Software Carousel is complicated and difficult to use. Not so. Particularly when you compare it to other programs like Windows and TopView.

Set it up once and Software Carousel remembers forever. Better still, Carousel will look for the programs you use most often and optimize them for quickest access.

The way we see it, there are certain things you have a right to expect from your computer. Access to your software is one of them. At just $59.95* a copy, Software Carousel is the best way to get it.

See Software Carousel at better computer dealers everywhere. Or order today by calling 800-272-9900 (603-627-9900 in NH), or mail the coupon below. If you find this product does not meet our advertised claims within 30 days of purchase we will arrange for a prompt refund.

Software Carousel $59.95*

YES! Send me_____copies of Software Carousel at just $59.95* each.

Name_____

Company_____

Address_____

City_____ State/Zip_____

Check Enclosed ☐ VISA ☐ MC ☐ AMEX ☐

Card #_____ Exp. Date_____

Signature_____

SoftLogic Solutions, Inc.
530 Chestnut Street
Manchester, NH 03101
800-272-9900
(603-627-9900 in NH)

SOFTLOGIC SOLUTIONS

Call today: 800-272-9900

*plus $5.00 shipping and handling.

sophisticated process, memory, or I/O services. A typical example would be a file server on a network or a database management system. Developing in this manner means that the application must provide system start-up and shutdown procedures just as if it were a shell. Of course, these procedures might be transparent to the user.

A third use of the OST is as an educational resource. The user's manual is packed with details about OST internals in addition to a good helping of MS-DOS information. The manual also has plenty of code fragments illustrating key points and lots of examples explaining how and why to use the enhanced system service calls that the OST provides. The section on writing device drivers is especially well written and contains an excellent discussion of the tty drivers. The manual is not introductory in nature, however. If you don't already know what a scheduler does in an operating system or what an asynchronous system trap is, the manual won't teach you. The text is aimed squarely at experienced DOS programmers and knowledgeable systems people.

Wendin should be congratulated for providing complete source code that is reasonably well documented and logically arranged. Everything from the assembly interrupt routines to the system header files is coded in a consistent fashion, with indentation and explanatory headers making the developer's job considerably easier.

Congratulations also go to the telephone support. It may not be toll-free, but the people on the other end understood my questions and seemed genuinely interested in what I was doing, as well as how I was doing it (I didn't mention that I was writing this article).

The best news is that anything created with the OST is royalty-free. You cannot distribute Wendin's source code with your application, however. That makes me want to write my own PCVMS operating system for people who want the feel of an IBM mainframe on their IBM PCs.

Conclusion

For users with sophisticated software ideas, the OST package is a steal at $99. Provided you have a Microsoft C compiler version 3.0 and a good editor, you can be immediately productive. Using another C compiler shouldn't be any big deal, but with so many variations of C on the market and with a complex piece of software like an operating system kernel, it wouldn't be any fun.

I heartily recommend the OST as an educational tool for experienced programmers of all types. The user's manual, combined with all the source code for everything in the OST, is an invaluable resource. If you don't want to build your own user interface or if you'd rather be able to look at the source code for a complete user interface, then PCNX and PCVMS are for you. They include the operating system (kernel and user interface), utilities (about 40 for PCVMS and 60 for PCNX), complete source code, and a user's manual. The user's manuals are geared toward explaining a particular implementation of the OST.

The Operating System Toolbox has its problems, mostly due to the deficiencies in MS-DOS and the 8088 microprocessor. A carefully planned application should benefit from the enhanced services and not fall prey to the shortcomings. You wouldn't, for instance, want three people doing software development at the same time; not only would the system load be oppressive, but the possibility of wiping out another user would be too risky in an environment where retention of data is critical. ■

Jason Levitt (P.O. Box 49860, Austin, TX 78765) is a UNIX consultant.

DATA ACQUISITION: Get system capability at a board-level price. The System 570 is a personal computer based Data Acquisition Workstation with the extensive signal capacity you need: **32** analog inputs (or 16 differential), **2** analog outputs, **16** digital inputs, **16** digital outputs, **16** power control lines. The price is only **$1425**, complete with our powerful **Soft500 software**, an extension of advanced BASIC that provides foreground/background architecture, array and memory management, disk access and storage, and over 45 additional commands.

AN expansion slot lets you extend your System 570's capabilities by selecting from an extensive library of optional input/output modules. And you can use the 570 with other data acquisition software such as DADiSP, ASYST™, and Labtech Notebook.

For complete information, a demonstration, or applications assistance, call toll free:

1-800-552-1115

(In Ohio call 216-248-0400.)

32
2
16
16
+16
$1425

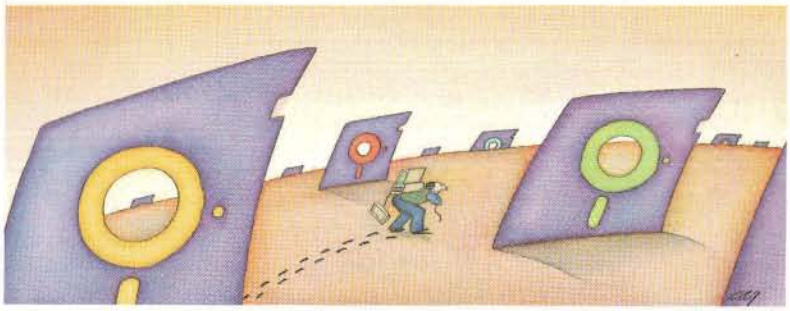


KEITHLEY

Inquiry 159

With all these SoftLogic Solutions, you could run out of problems.

Now there's a whole family of low-cost, easy to use SoftLogic Software for the IBM PC, XT, AT, and compatibles. They'll save you time, aggravation, and lots of money. Got a problem? Check out these SoftLogic Solutions.



Software Carousel™—The easy way to move from one program to another.

Now keep up to ten different programs loaded and ready to run—and switch from one to another in an instant. Plus use all available memory with each and every program. Supports AboveBoard™ and RAMPage.™ New Version 2 is even faster and more powerful.

$59.95*

Disk Optimizer™—Speeds up your disk by cleaning up your files.

You may not notice, but your hard disk is getting slower. Because your files keep getting fragmented and scattered on your disk. Disk Optimizer puts back the speed by putting your files back in one piece—where they belong. Now faster, with even more powerful features.

$59.95*





Cubit™—Packs more of your data onto less disk space.

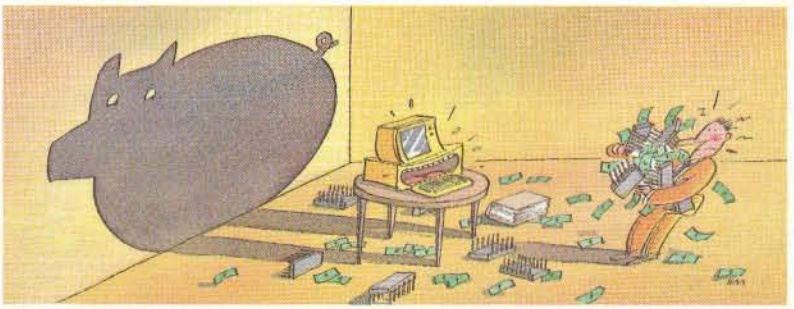
Filling up your hard disk again? Don't run out and get a bigger drive. Get Cubit, and get up to twice the storage capacity from the drive you already have. Cubit compresses and decompresses word processor, spreadsheet, database, all kinds of files—quickly, safely, invisibly.

$49.95*

DoubleDOS™—The multitasking software that takes less of everything.

You can spend more money, load more memory, and read more manuals with systems like TopView™ or Windows.™ Or you can get DoubleDOS, the amazing concurrent software system that lets you and your computer each work on different tasks at once.

$49.95*



NOT COPY PROTECTED!

SOFTLOGIC SOLUTIONS
SoftLogic Solutions, Inc.
530 Chestnut Street
Manchester, NH 03101

Put your problems behind you! Order today!

Look for SoftLogic products at better computer dealers everywhere. Or order direct from SoftLogic Solutions by calling 800-272-9900 (603-627-9900 in NH).

800-272-9900
(603-627-9900 in NH).

* plus $5.00 shipping and handling.

© 1987 SoftLogic Solutions, Inc.
TM signifies manufacturer's trademark.

When you buy a terminal or monitor for your American PC, you want a low price, but not something foreign. You want American quality. American specs. An American look and feel.

Which really means you want the kind Uncle Samsung makes.

Because Samsung has been making them that way in Korea since 1979. For some of America's largest PC manufacturers. So they're already as familiar as the 4th of July.

But now you can buy Samsung terminals and monitors with Samsung's name on them. And save yourself plenty of Yankee dollars.

Our 12" and 14" terminals emulate all of America's most popular models. Our monitors do too, and come in a range of cabinet styles.

And our stateside group, Samsung Electron Devices, has an American design team on staff to answer queries and help OEMs with custom designs. Just call (213) 404-1835.

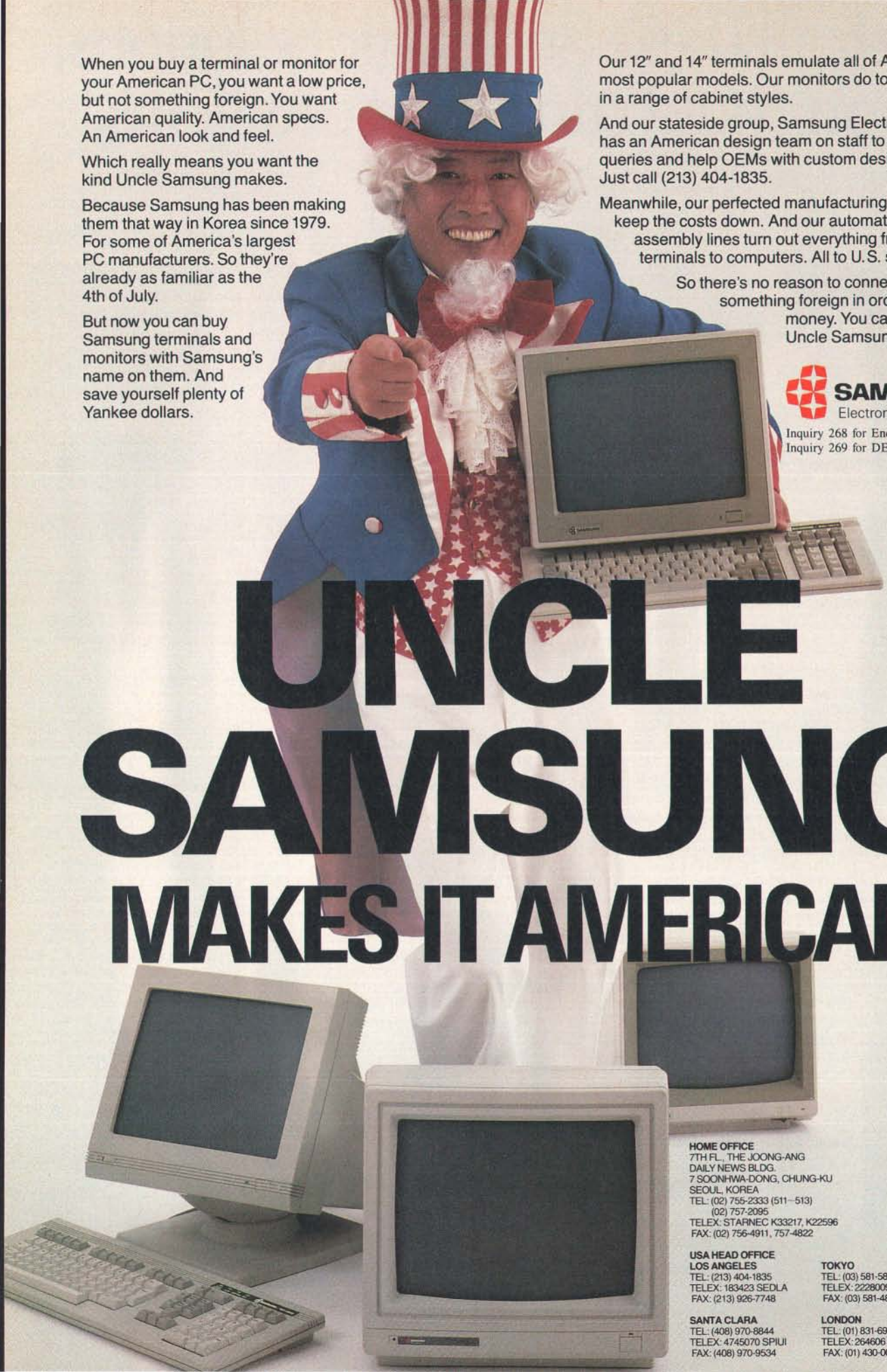
Meanwhile, our perfected manufacturing techniques keep the costs down. And our automated, robotic, assembly lines turn out everything from CRTs to terminals to computers. All to U.S. standards.

So there's no reason to connect your PC to something foreign in order to save money. You can join up with Uncle Samsung.

SAMSUNG
Electron Devices

Inquiry 268 for End-Users.
Inquiry 269 for DEALERS ONLY.

UNCLE SAMSUNG MAKES IT AMERICAN



HOME OFFICE
7TH FL., THE JOONG-ANG DAILY NEWS BLDG.
7 SOONHWA-DONG, CHUNG-KU
SEOUL, KOREA
TEL: (02) 755-2333 (511–513)
(02) 757-2095
TELEX: STARNEC K33217, K22596
FAX: (02) 756-4911, 757-4822

USA HEAD OFFICE
LOS ANGELES
TEL: (213) 404-1835
TELEX: 183423 SEDLA
FAX: (213) 926-7748

SANTA CLARA
TEL: (408) 970-8844
TELEX: 4745070 SPIUI
FAX: (408) 970-9534

TOKYO
TEL: (03) 581-5804, 581-9521/4
TELEX: 2228009 SANSEI
FAX: (03) 581-4835

LONDON
TEL: (01) 831-6951/5
TELEX: 264606 STARS LG
FAX: (01) 430-0096

PFS:First Choice

Larry D. Allen

Word processing, spreadsheets, file management, and more

PFS:First Choice, an integrated package for IBM PCs and compatibles, is designed for the first-time computer user. PFS:First Choice combines word processing, a spreadsheet, telecommunications, and file management in a package that is simple to learn and use. The first release, which costs $149 and requires at least 256K bytes of memory, needs several improvements, including a lot more speed. Some users may quickly find that they require more sophisticated features, but Software Publishing is right on track for its target customers.

PFS:First Choice is tightly integrated; each application is called from a common menu and employs the same user interface. You select functions and features via menus that are displayed when you press function keys. Alternatively, the most common commands have "speed keys" that you execute by pressing Alt in combination with a letter key. You can easily move data from one application to another via a clipboard. You can place up to six "bookmarks" within word processing, spreadsheet, or file-management data, which allows you to jump to and from specific places in each of the applications without going through the main menu. This is also helpful during cut-and-paste operations.

If you elect to bring up an existing document from the main menu, a directory is displayed with the files organized by application in sorted columns. Each type of file has its own extension name. Selecting a file opens the correct environment for that file automatically (e.g., word processor or spreadsheet). File size is limited by RAM; the program itself takes up approximately 187K bytes. An indicator showing the percentage of filled memory appears at the top of the screen.

Word Processor

The word processor is not designed for the user who cares about fancy formatting, jazzy cursor movements, or alternate-side page numbering. It is for those who want to put out decent-looking letters and memos with minimal learning time.

Some things about PFS:First Choice took some getting used to. For instance, pressing Tab does not insert a Tab character, even in Insert mode; it simply moves the cursor to the next tab stop. For word wrap, the cursor stays on top of the last character at the right margin instead of moving one character past the margin. This is fine unless a word ends right at the margin and you try to add characters to the word later (to make it plural, for example). Since you can't place the cursor to the space past the word, the only option is to delete the word and retype the longer word, which then properly wraps to the next line.

Text styles, including bold, italic, underlined, superscript, subscript, and centering are supported, but you must first enter the text and then select and define it with the desired style. You cannot simply turn on Bold mode and turn it off again when you've finished typing bold text. All styled text is displayed on the screen in reverse video, or as yellow text on a color monitor. To know what style a particular piece of text is in, you place the cursor on the text and press the Style function key. The Style window then pops up with a menu of available styles and displays a dot beside each style currently defined for the highlighted text.

The word processor's merge capability is easy to use and can access records stored in the file manager. For addressing labels, only single columns of labels are supported. Headers and footers are also supported, up to two lines for each. PFS:First Choice has no Undo key. However, you can restore marked text that has been cut to the clipboard.

The word processor and other applications have a Print menu with options that let you define the page length, page width, compressed or normal print, and draft or correspondence quality. The word processor provides a JOIN command that permits you to append multiple documents together at print time. When printing on a Hewlett-Packard LaserJet, I had to define my page length as 60 lines instead of 66. Software Publishing says this is because the LaserJet does not print on the top or bottom half-inch of the page.

PFS:First Choice comes with a 75,000-word dictionary for its spelling checker. The spelling checker employs a root-word algorithm. It also warns of numbers with misplaced commas, improper capitalization, and repeated words (e.g., *the the*). A word count is not provided.

Complex writing tasks may require features that you won't find in PFS:First Choice. You cannot exit temporarily to DOS, change fonts in a document (although printer codes can be embedded in a document), use proportional fonts, manipulate columns, rename a file, use 1½-line spacing, erase to the end of a line, perform a timed backup, automatically create a backup file, employ continuous underlining, move the cursor a page at a time or to a particular page, or perform a find-and-delete operation.

PFS:First Choice does not require you to enter the name for a newly created word processing or spreadsheet document until you save it. Curiously, the file manager requires a filename first, and the file is created immediately, even if you change your mind and exit that application.

PFS:First Choice is not upward-compatible to PFS:Write or PFS:Professional Write. Also, PFS:First Choice's user inter-

continued

Larry D. Allen is a senior electronics engineer for Advanced Technology Inc. (242 South Main St., Dumfries, VA 22026), where he works on office automation and signal processing projects.

PFS:First Choice version 1.0

Type
Integrated word processing, spreadsheet, telecommunications, and file-management program

Company
Software Publishing Corp.
1901 Landings Dr.
Mountain View, CA 94043
(415) 962-8910

Format
Two 5¼-inch disks; not copy-protected; also available on 3½-inch disks at no additional charge

Computer
IBM PC, XT, AT, or compatible with at least 256K bytes of memory (384K bytes if using MS-DOS 3.2); one double-sided 5¼-inch floppy disk drive; color or monochrome monitor; telecommunications function requires a modem (25 models supported); supports 8087 and 80287 math coprocessors

Language
C, assembly language

Documentation
User's manual, 220 pages

Price
$149

face is dissimilar enough from PFS:Professional Write that if it becomes necessary to upgrade to a product with more powerful features, PFS:First Choice users might as well consider other brands.

Spreadsheet

The package's spreadsheet has a few interesting twists. A column and row outside of the regular cells is reserved for headings. As you enter text into a heading cell, the column automatically expands to hold the text. Certain headings are especially easy to enter by using the program's Quick Entry mode. While in this mode, moving to the next heading cell automatically enters *Tuesday* if the previous heading was *Monday*. Similarly, *Feb* follows *Jan*, and *Week 2* follows *Week 1*.

Quick Entry mode also serves as a semireplicate key. Moving from cell to cell automatically copies the previous cell's formula into the next cell, adjusting the formula in the process. The program does not have a one-to-many replicate function. It is possible to select a group of cells and copy or move them to a new location, where the formulas automatically adjust. You cannot selectively adjust individual formulas during a copy operation; that is, you cannot adjust one cell reference and not another (unless you use named cells).

Cells are referenced by row and column number (e.g., R12C14), which requires more keystrokes than SuperCalc's "L14," for example. Alternatively, you can name a cell and refer to it in other cell formulas by that name. Common trigonometric, statistical, and financial functions are built into the spreadsheet. Conditional IF. . . THEN. . . ELSE logic for formulas is provided, as well as a Lookup function. You must be careful when entering text in cells because overflow text actually overwrites data in adjacent cells.

A global format change, such as displaying numbers to four decimal places, affects only new data. Existing data keeps whatever format it had when it was entered unless the cells are blocked and a new format (or style, as PFS:First Choice calls it) is defined. When you're copying cells, the program gives no feedback while you're waiting for the copy operation to finish and recalculation to begin. PFS:First Choice is extremely slow, and long waits with no user feedback are possible.

You do not define a formula in a cell by simply typing it in, as with SuperCalc version 4; instead, you select a menu option to define or edit a formula, and a window pops up with a space for you to define the formula. While this window is displayed, you can move the cursor from cell to cell, and the formula (and its name, if any) for each cell will be displayed. Unfortunately, the formula window always pops up in the same place, which may be covering the cell you're looking at. Also, you can move along only a single row. To move up or down to a new row, you must first exit the formula window, move to the new row, and then redisplay the formula window.

According to Software Publishing, PFS:First Choice's maximum spreadsheet size with 640K bytes of RAM is 1024 rows by 768 columns. Using MS-DOS 3.1 with 640K, however, I reached the memory limit with a standard spreadsheet measuring 173 rows by 25 columns. The standard spreadsheet simply multiplies the previous cell by 1.001. With the spreadsheet at the memory limit there is no clipboard room. PFS:First Choice does not have a spreadsheet-consolidation function.

File Management and Reports

The file manager is of the genre usually referred to as card-file managers. You define a database by simply typing the desired field names where you want them to appear on the screen. Field names end with a colon. You cannot define a length or type for each field; the field will expand as necessary to hold whatever data you type in. You can define up to 1000 fields, and each record can have a maximum of 21,000 characters. On a hard disk, you can have up to 16,000 records.

The program's database is not sorted or indexed. When perusing the database, you can choose to find records by exact match, partial match, relative match, or negative match. A partial match request searches for records with fields that end in, begin with, or contain the desired string. A relative match request searches for entries that are less than, greater than, or equal to a given number. Software Publishing opted to use the symbol /< to mean less than or equal to instead of the more common < = . The Search field can contain other characters, such as a dollar sign ($); everything except numbers is ignored. A negative match request lets you search for everything but a particular partial or relative string.

When entering or editing information in a folder, you can use the word processing functions. However, there is no "blank field" command; you must use the space bar to blank out unwanted text. You can easily redesign a folder by changing field names, relocating them on the screen, or adding names without losing existing data (unless a field is deleted). I can't imagine the process being easier than it is with PFS:First Choice.

Reports

The file manager's report capability is limited. You define which fields you want to appear on the report and the order they are to appear in, along with any search criteria. The report is then printed in the conventional one-record-per-line format with a column for each field. A report can have up to 20 columns, but you are warned before printing if there are too many columns to fit on the paper.

If you wish, the report will be sorted in ascending or descending order from the first field. You can perform calculations, including total, average, and count, on columns. You can also request subtotals, subaverages, and subcounts for each time the information in the first column changes. You can specify a numeric code for a column, which means all information in that column is treated numerically; text is ignored, decimal points are aligned, and trailing zeros are added to make each entry the same length. You can define an invisible column and use the data in it for calculations; this column is not printed. A report definition can be saved for later use.

Since there is no need for a field-length definition, the report generator scans the database prior to printing the report and

sets the column widths to fit the largest entry in each column. For fields with long data strings, such as comment fields, the report generator wraps excess text to the next line within its column. For getting sorted information out of a semi-free-form database, PFS:First Choice has made the process exceedingly simple.

Telecommunications

When you select "Connect to another computer" from the main menu, another menu appears in which you can define up to eight communication services, such as The Source, CompuServe, or BIX. A ninth menu selection is for answering incoming calls. You define a service by filling in an information form with the name to appear on the menu, the phone number, communication parameters, and whether or not to create an automatic sign-on sequence.

If you opt to create an automatic sign-on, the program remembers each step you take the first time you sign on to the communication service until you tell it to stop remembering. I was able to get PFS:First Choice to consistently sign on to BIX and other single-data-rate bulletin boards; however, it could not handle services that answer the phone and do not output text immediately (multiple-data-rate bulletin boards are in this category because they wait for a keystroke or two from you to determine your data rate). PFS:First Choice must see something it recognizes before sending the next sequence of text to the remote computer. Unlike with Crosstalk, you cannot tell PFS:First Choice to wait a given period and then do something. Otherwise, the automatic sign-on is exceptionally easy to use. You cannot edit the automatic sign-on sequence; to change it, you must recreate it.

A nice feature of PFS:First Choice's telecommunications application is that the program automatically places you into the word processor when you are connected to a remote service. You don't have to bother with turning a Capture feature on, as with Crosstalk. At any point while online, you can scroll back through the session and edit it as desired, saving the session if you wish.

A Noble First Try

I appreciated the error trapping in PFS:First Choice. The program does not hang up if you try to print and the printer is not ready. Instead, the program displays a polite "The printer is not ready" message. Similarly, if a disk is not in the requested drive, the program displays a "Drive not ready" message. When I tried to exceed the 100 percent full indication, a "Not enough memory" error message was displayed.

PFS:First Choice is a noble attempt to bring the most commonly needed applications to the first-time computer user or to the user who doesn't wish to spend the time to become proficient with more powerful products. However, I would like to see some improvements such as column support, font changes, and an Undo feature. Such improvements would make it less likely that a user would quickly outgrow the software. Also, while it may not be as important to a first-time computer user, PFS:First Choice should be made to run faster, especially for those who do many find-and-replace tasks or work with large spreadsheets. ■

WriteNow for the Macintosh

Mick O'Neil

WriteNow for the Macintosh version 1.00 by T/Maker is a word processing program that runs on the 128K-byte and 512K-byte Macintosh and the Macintosh Plus. It requires a minimum of 128K bytes of memory.

The first thing that struck me about WriteNow is that its authors must have taken a hard look at the shortcomings of MacWrite and set out to rectify them. Once that was done, they added a few of their own features to make this software a serious contender in the Macintosh word processing market.

The most impressive aspect of WriteNow is its overall performance. It does about everything you would want a word processor to do and does it very well. In addition, its full range of features is accessible directly from pull-down menus.

The program also handles long documents as smoothly as two-page letters. In fact, when I received an early copy of the software, I also received a disk with the 175-page manual in the form of a WriteNow document that I could access and scroll through easily.

Special Features

WriteNow incorporates a variety of advanced features, including the following:

• **Backups**. Suppose that you delete 20 pages from a document and then change your mind? WriteNow includes a Revert

continued

Table 1: *The results of performing various functions with WriteNow using a 4000-word text file converted to proper format. All tests were done on a Macintosh Plus with the system file loaded on a RAM disk with the program disk in the internal drive and the data disk in the external drive. "Run program" shows the time required to run the program directly from the Finder. "Load document" refers to the time required to load a document while the program was running, while "Load from Finder" results from double-clicking the document icon while in Finder mode. "Save document" refers to the first save of a formatted text file, and "Save revision" shows the time required to resave the same document after it has been revised. "Search document" indicates the time required for the program to find a unique word inserted at the end of the file, and "Scroll document" refers to a manual scroll from the beginning of the document to the end. Times are in seconds.*

	WriteNow 1.00	MacWrite 4.5	Microsoft Word 1.0	Laser Author 1.0
Run program	20.3	15.7	12.4	61.0
Load document	11.5	14.4	5.6	4.8
Load from Finder	17.9	26.6	15.7	52.0
Save document	10.6	12.4	23.2	16.5
Save revision	3.8	7.4	20.0	8.8
Search document	1.5	7.2	17.9	45.0
Scroll document	82.9	64.5	73.5	55.0

WriteNow for the Macintosh version 1.00

Type
Word processor

Company
T/Maker
2115 Landings Dr.
Mountain View, CA 94043
(415) 962-0195

Format
Two 3½-inch floppy disks

Language
Assembly language

Computer
128K-byte Macintosh; 512K-byte Macintosh; Macintosh Plus

Documentation
User's manual, 175 pages

Price
$175

to Saved command that simply ignores your latest revisions and a Revert to Backup command, whereby you can replace the last saved version of your document with the previously saved version.

• **Page Setup**. WriteNow includes a well-designed Page Setup function that automatically scales margins, tab settings, and indentations to maintain relative positions under various page widths. Other options give you control over automatic footnote numeration, binding margins, printer spacing, page wrap, and ruler reduction.

Perhaps the most dramatic formatting control concerns multiple columns. You can specify up to four columns, and WriteNow will divide the body and footnote regions of each page into that number of equal-width columns, with text flowing from one column to the next. The ruler starts at zero at the left edge of each column, and the ruler settings are scaled accordingly. The actual division of the page into individual formatting areas means that you can edit or change the format of text within a column without affecting the appearance of the adjacent columns.

Formatting text into columns has its trade-offs: Graphics larger than one column wide are automatically cropped to fit. These can be resized or you can include a larger-than-column-size graphic in the header or footer.

• **Full View**. To make exact formatting possible, WriteNow allows you to view a document in several different ways. You can examine the normal typing area by simply viewing the page, while headers, footers, and footnotes have their own window to illustrate their ruler setup and spacing. Particularly valuable options include the ability to view while showing markers, which graphically illustrate all headers, footers, time and date insertions, soft hyphens, and page numbers; and the ability to view while showing space, which provides a dotted outline around your text that depicts page margins and header and footer boundaries. It also shows all nonprinting characters, such as return characters, spaces, tabs, and page breaks.

• **Spelling Checker**. WriteNow uses a menu-driven 50,000-word dictionary to check the spelling in a document. The spelling checker includes several helpful buttons. The Find button finds the next word not included in the dictionary. The Guess button lists alternative spellings for a questionable word. Learn adds a word to the dictionary, Forget removes a word from the dictionary, Ignore skips a word designated as misspelled, and Load Dictionary uses a dictionary of your choice.

• **Import/Export**. Included on the disk with WriteNow is a program called Translator, which can take a MacWrite or Microsoft Word document and translate it with much of its formatting into a WriteNow document. The program also translates files in standard text format into WriteNow's format and allows you to save a WriteNow document as ordinary text. The latter capacity allows WriteNow to import and export documents to database programs or spreadsheets.

Finishing Touches

WriteNow includes a number of finishing touches, that is, small logical jumps from MacWrite that allow you a little more control. For example, the Find and Replace command can use wild cards. The ruler includes a point-by-point spacing toggle, and the page-break symbol is a broad, shaded band (no isolated "=," as in Microsoft Word). You can change default ruler settings by including a piece of stationery in the same folder as WriteNow. You can increase or decrease font size with a key combination. You can insert soft hyphens for better formed text and set off paragraphs by indenting left and right from the Format menu. You can also alter the distance between letters (kerning) to optimize printing and add and insert a variety of headers and footers on different ranges of pages. This is not an all-inclusive list of WriteNow's features, but it does give you some insight into the program's sophistication.

The program comes with a well-written and nicely illustrated 175-page manual containing a user's guide and a reference section. T/Maker has joined the growing group of software developers issuing unprotected software, so there is no problem with backups or installing WriteNow on a hard disk. I found the program very solid, fast, and predictable.

Like Laser Author (which I reviewed in the January issue of BYTE), WriteNow is not the complete Macintosh word processor. The biggest reservations I have concern its inability to merge text to produce form letters and the lack of a glossary for easy entry of boilerplate phrases or blocks of text. If you have no need for these features, WriteNow for the Macintosh is well worth a look. [Editor's note: *See table 1 for complete benchmark results.*] ■

Mick O'Neil (Box 544, APO, NY 09378) is a computer coordinator for the U.S. Department of Defense dependent schools in the U.K. and a freelance writer for several international journals.

CAD-3D

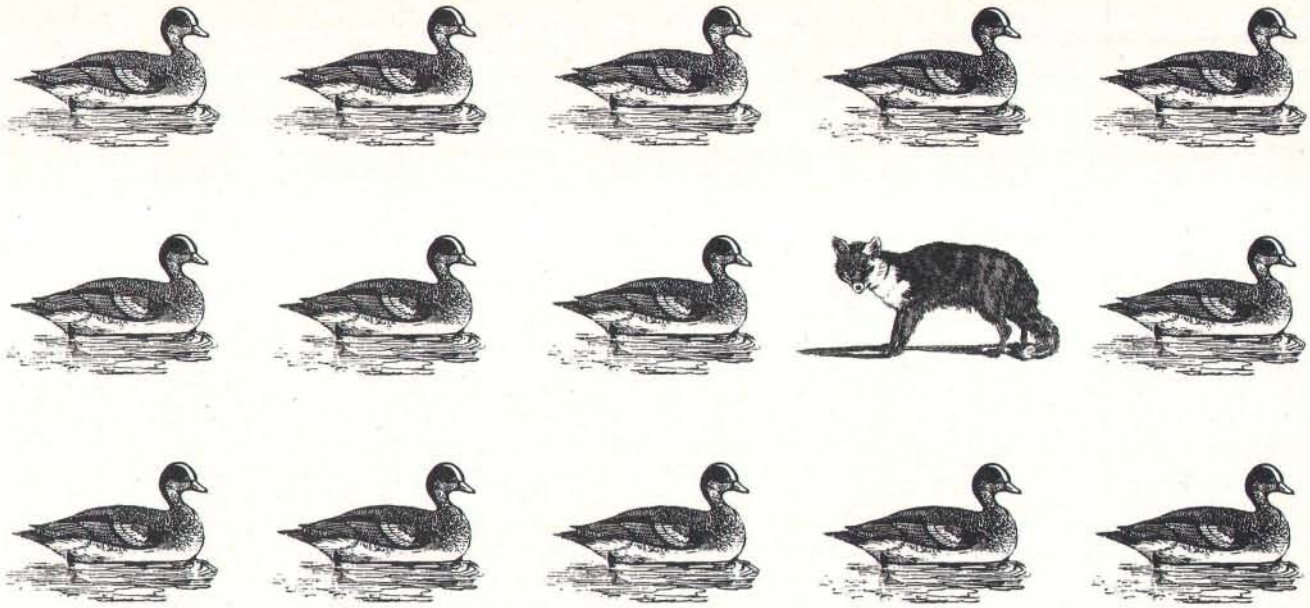
Rusel DeMaria

CAD-3D from Antic Software is a three-dimensional modeling program for the Atari ST. Written by Tom Hudson, author of NEOchrome and DEGAS, CAD-3D offers sophisticated control of wire-frame or solid objects in up to four simultaneous views. The program allows you to control up to 20 objects, join or animate objects, and export color pictures to paint programs like NEOchrome and DEGAS.

When you first load the program, the screen displays four windows and a group of pull-down menus. Each window contains a different view of the objects you create. Three of the windows offer a choice of views. For instance, one window offers a view either from the right or the left side. The others offer top and bottom or front and back views. You can select or change the settings in these view windows at any time. By pressing the button in the upper left corner that normally closes a GEM window, you toggle the size

continued

Turbo Programmers:



Find the culprit fast with T-DebugPLUS.™

You're programming, getting all your ducks in a row, but there's a culprit in there, a bug. T-DebugPLUS, the new symbolic run-time debugger, helps you find that bug and fix it faster than ever before.

In Command. In Control.

See what happens *as* your Turbo Pascal programs run...examine variables...change values...be in control. The top half of your screen displays the source code, current line highlighted. You debug interactively on the lower half. All variable types are accessible, local and global. Set breakpoints at a procedure, function, or statement number.

Instant Gratification.

T-DebugPLUS integrates invisibly, automatically loading Turbo Pascal. Switch instantly between the debug and output screen. Jump instantly to the editor to fix that bug.

New...Debug in Overlays.

Debug in overlays with release 1.04. Examine areas of memory and CPU registers. A MAP generation utility even lets you use an external debugger on your program. T-DebugPLUS is only $60.

"T-DebugPLUS: Don't program in Turbo Pascal without it."

Neil Rubenking
PC Magazine

More Power. More Productivity.

Turbo EXTENDER™ helps you break the 64K barrier for both code and data; use all 640K. A source code converison program, make facility, and run-time routines make writing and compiling large programs dramatically easier. Turbo EXTENDER is only $85.

TurboPower Utilities™ supplies nine powerful programs. Four Pascal utilities, including the acclaimed Pascal Structure Analyzer and Execution Timer, help you write programs that are bug free, faster, and easier to document. Five PC-DOS utilities help you analyze, change, and find your program files. TurboPower Utilities is only $55 for executable, $95 with source.

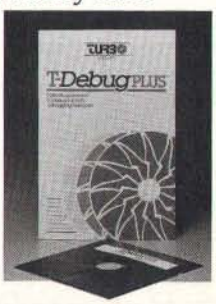
"Impressive products...I recommend them."

Philippe Kahn, President
Borland International

Satisfaction guaranteed or your money back within 30 days.

Call toll free for credit card orders:

800-538-8157 x830
outside California or
800-672-3470 x830
in California



Shipping and taxes prepaid for U.S. and Canadian customers. Others please include $6 per item for shipping.

TurboPower Software products require Turbo Pascal 3.0 (standard, 8087, or BCD) and require PC-DOS 2.X or 3.X, and run on the IBM PC/XT/AT and compatibles.

TURBO Power

TurboPower Software, 3109 Scotts Valley Dr. #122
Scotts Valley, CA 95066
Call 408-438-8608 for more information (M-F 9AM-5PM PST).

CAD-3D version 1.0

Type
Three-dimensional modeling system with animation capabilities

Company
Antic Software
524 Second St.
San Francisco, CA 94107
(415) 957-0886

Format
One 3½-inch disk; not copy-protected

Computer
Atari 520ST or 1040ST with at least 512K bytes of memory; one disk drive (second drive recommended)

Language
C, assembly language

Documentation
User's manual, 30 pages

Price
$49.95

and rotation controls for each window. Scroll bars at the bottom and right side of each window control these functions.

The fourth window is the Camera window. It allows you to view objects as if from a camera. You can change the amount of perspective, zoom in and out, and rotate the camera relative to the three-dimensional images. You can also take a Super View, or color snapshot, of the image in the Camera window. On monochrome systems, you can get a high-resolution image of the Camera view.

You can zoom any window to full-screen size and activate or deactivate any window you choose. With more complex objects and shading it can take quite some time to redraw the screen in each window, so closing nonessential windows speeds up the performance of the program.

All commands are available using GEM-like pull-down menus, and most of the commands have keyboard equivalents as well.

Creating a CAD-3D Object

Several standard objects are available under the Generate menu. You can create a cube, three increasingly complex spherical objects, a wedge, or a torus (doughnut) shape. If one of these shapes is not what you want, you can use the Spin and Extrude tools to create more complex objects.

Spin is essentially a lathe tool. You work on the right side of a special connect-the-dots–type screen and define a figure one point at a time for up to 32 points. Any figure you outline is mirrored on the other side of the dividing line. When you are satisfied, you use the Do Spin command, creating a three-dimensional object that follows the outline you have created. This is an excellent tool for creating radially symmetrical objects like goblets, light bulbs, vases, or bowls.

Optional features include Rubberband, which shows the connecting line from the last point created; Connect, which automatically closes a figure; Grid, which shows an even grid; and Snap, which automatically moves points onto grid lines for more precise control. Also, you can remove erroneous points or use the Undo key to back out of an error.

Extrude is another tool for creating a new object. It is similar to Spin, but you can use it to create asymmetrical objects. It works on a similar screen, but in this case you use both sides of the center line. You must draw clockwise and avoid crossing or intersecting lines, but otherwise you can draw virtually any outline you wish (up to 50 points). You can also use the Grid, Snap, Rubberband, Remove, and Undo options. Extrude automatically closes all figures, so Connect is unnecessary here.

With both Spin and Extrude, you can select the number of segments—up to 50 with Extrude and up to 48 with Spin—that the figure will contain. This is especially useful with round figures, since increasing the number of segments increases the smoothness of the object. It also increases the time it takes to draw and redraw the object.

After you have created objects, you may want to join them. Joining objects allows you to create complex three-dimensional models and allows you to exceed the 20-object limit effectively. You can achieve several effects with the Join command. Besides simply adding two objects to make a third, you can subtract the overlapping area of one object from another, create an object that consists of only the overlapping part, or stamp one object onto another, creating a two-dimensional image of one object on the surface of another. Most Joins go quickly, but with very complex objects the process can take quite a long time—up to several hours. In some cases, two planes on the joining objects may exactly match. If this is the case, you must move or rotate one of the objects at least one degree to allow the Join.

Manipulating Objects

After you are satisfied with the objects you have created, you manipulate them. You can select wire frame (the default), hidden lines, solids, or outlined shapes. Selecting Edges Only with the Outline mode shows a clean solid shape with all facets visible. This is my favorite way to view objects. Whatever display you prefer, you can select and deselect objects on the screen, drag them to new positions, or use the scroll bars to resize or rotate them.

With solid models you can use up to four different light sources to achieve different shading effects. Although objects display on the screen in monochrome, in Super View each object can display in one of two different colors, and you can have up to seven different shadings of those colors. You set your light sources for one of seven intensity levels and for direction. For three light sources, you can choose any combination of top/bottom/center, right/left/center, and front/back/center. The fourth light source is ambient light, for which you choose the intensity. You can also display Super View objects in 14 shades. This mode creates pastel effects but allows only one color at a time.

To select an object, you simply double-click on it; other objects then disappear from the display. You can select any combination of objects from the Select option under the Objects menu and drag any object to a new position in any window except the Camera view. You can also set the program to drag only vertically or horizontally for more precise positioning.

You can scale objects from 50 percent to 500 percent. The Scale command works in all three dimensions, whereas sizing in the windows works on only one dimension at a time. You can also select Rotate from the Objects menu. This command causes the object to rotate in one dimension. With both Rotate and Scale you can use either the Universe or the Group mode. Universe mode rotates and scales relative to the center of the three-dimensional universe. Group mode rotates or scales relative to the center of the currently selected group of objects.

One use of the Group mode is to create an animated spinning object. Rotating a single object set for Group mode causes it to spin on its own axis. If the setting is for Universe mode, the object will rotate around the universal center instead of spinning.

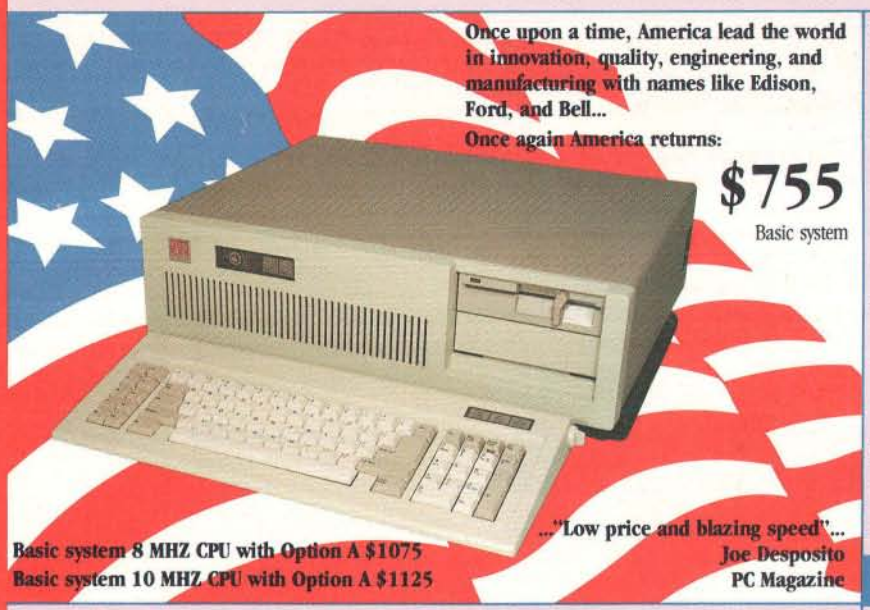
Animation

Possibly the most impressive aspect of CAD-3D is its animation. Beta versions of the program allowed a slow, space-consuming type of animation, but the techniques are improving rapidly. Currently you can have animation moving at up to 60 frames per second; broadcast quality is only 25 to 30 fps. Also, compression techniques allow you to store much more data on a single floppy disk. At the time of this writing, the program allowed up to 20-to-1 compression, but Antic prom-

continued

Inquiry 56 ⟶

The American Success Story:



Once upon a time, America lead the world in innovation, quality, engineering, and manufacturing with names like Edison, Ford, and Bell...

Once again America returns:

$755
Basic system

Basic system 8 MHZ CPU with Option A $1075
Basic system 10 MHZ CPU with Option A $1125

..."Low price and blazing speed"...
Joe Desposito
PC Magazine

FEATURES:

* Maxi switch keyboard
* 6/8/10 MHz selectable, depends on model
* 1MB of inboard memory (with 512K standard)
* 8 I/O expansion slots
* 195 watt power supply, 110V/220V switchable
* Fully compatible BIOS (written in U.S.A.)
* Full documentation, operation manual with binder
* Full one year warranty

FREE:
Fully configured and tested for your system requirements

RUNS:
NOVELL, DBASE, AUTO CAD, LOTUS, XENIX, SIDEKICK

"If imitation is the sincerest form of flattery, the CLUB AT pays the IBM AT a heartfelt compliment. The only failing of the (CLUB AT) is that it imitates the IBM machine too accurately;...and you can't beat that..."

Karl Koessel **PC World** December 1986

Option A: 1.2MB Floppy Drive WD HD/Floppy Controller

CLUB 286 Mono system $1311
* Complete system as described above plus mono display card and IBM quality mono monitor

CLUB 286 Color EGA system $1742
* Complete system with EGA card & monitor

CLUB 286 Color system $1508
* High quality
* Complete system as above
* Plus color display card and color monitor
* Fully assembled and tested, no installation required

EVEREX EVERCOM

"Fully Hayes™ Compatible"

300/1200 BAUD **$128**



1200/2400 BAUD **$249**



300/1200 BAUD, half size/half power, excellent for long distance calls, free BitCom communications software

GRAPHICS BOARDS



CLUB EGA **A. $228**



CLUB MICRO EGA **B. $238**



132 HERCULES COMP. MONO **C. $99**

MONITOR



D. MONO $138



E. COLOR $345



F. EGA $480

NEC Multisync **CALL**

MULTIFUNCTION CARD



MULTIFUNCTION CARD FOR AT (CLUB 2000) **G. $179**

MANAGER'S CHOICE



I/O FOR PC/XT/AT **H. $75**



MEMORY CARD FOR CLUB 3000 **I. $155**



MEMORY CARD FOR PC **J. $55**



6-PAC COMPATIBLE CLUB 384 **K. $88**

HARD DISKS TAPE BACKUP SUBSYSTEMS

L. FAST HARD DISK FOR AT



20 MB 4026	$528
30 MB 4038	$628
40 MB 4051	$699
72 MB (23 MS)	$1195
80 MB 4096	$1295

M. FOR PC UPGRADE TO XT



	INTERNAL
20 MB	$375
30 MB	$475

WITH FLOPPY CONTROLLER ADD $50 (20MB only)

EXTERNAL TAPE BACKUP SOFTWARE INCLUDED



	INT	EXT
20 MB	$580	$680

N.



60 MB $747 $827

L. 39 ms access time, auto head parking, linear voice coil activator, one year limited warranty, cables, AT sliding rail and software included.

M. 65 ms access time, boots from hard disk, Western Digital controller, manual, cables, hardware and software included, 20/30MB Seagate Hard Disk.

N. 20 or 60MB backup, menu driven software, backup 5MB per minute, image & file-by-file backup.

G. Game port, parallel port, 0-2MB memory, runs at 12 MHz, 2 serial ports (2nd optional)

H. Parallel port, real time clock/calendar, 2 serial ports (2nd optional).

I. Club 3000 No piggy back, 0-3 MB capacity, 64K/256K RAM chips.

J. Club 576 (for PC Portable) software, short card, 0-576K memory, supports 64K/256K DRAM.

K. Club 384 Serial port, parallel port, 0-384K memory, clock/calendar, game port and software.

A. Parallel port, 256K Video memory, runs color/ mono display, 16 colors, 640 x 350 resolution.

B. Same as A, no parallel port, short card, and with Hercules emulation.

C. Printer port, monochrome graphics, runs Lotus 123/graphics, 132 x 44 column display.

D. Nonglare, 12" screen, 800 x 350 resolution.

E. 640 x 200 resolution, IBM quality.

F. 640 x 350, 640 x 200, EGA and CGA.

OTHERS

HARD DISK CONTROLLER

* Data Switch Box	$88
* PC/XT controller	$90
* Floppy controller	$49
* 25 Pin Serial Cable	$18
* Split Power Y-cable	$8
* IBM Type Printer Cable	$15
* IBM AT Bus Extended Card (good for test & debug)	$30
* AT HD/Floppy Controller	$170
* Compaq 286 HD Controller	$188
* PC/XT/HD Floppy Controller	$140
* Mouse	$75

WEEKLY SPECIALS
Qty. of 2

Toshiba 72 MB	$1099
Teac Floppy 360K	$85
Seagate 4051	$638

SOFTWARE

Graphics DR. HALO	$49
Communications BIT-COM	$49

ADD ON

* Kits for Mini I/O, 2nd Serial Port	$25
* Kits for CLUB 2000, 2nd Serial Port	$25

CHIPS





64K DRAM		256K DRAM	
		150 ns (9 pcs.)	$27
150 ns (9 pcs.)	$9	120 ns (9 pcs.)	$36
120 ns (9 pcs.)	$12	100 ns (9 pcs.)	$45

CLUB AT INC.

46707 Fremont Boulevard, Fremont CA 94539
Quality and volume is Our Business
All Sales Call (415) 490-2201
FAX No. 415-490-2687
Now open 7:30-6:30 for your convenience

University P.O.'s are welcome — Quantity Discounts are Available
Corporate Buyer call for Neil Mehta — Dealers are Welcome

ORDER BY MAIL: Check or Money Order, California add 6.5% tax
ORDER BY PHONE: C.O.D., Cashier Check, VISA (3%), American Express (4%) or Approved Company P.O.
TERMS: All prices are subject to changes and quantity may be limited and we reserve the Right to Substitute Equivalent Items. Unauthorized Returns are subject to 10% Restocking Fee. Call for RMA Numbers for Returns and Repairs. IBM, Hercules, Bitcom, Xenix are trademarks of the Respective Companies. Limited Warranty, 1 year parts and 6 months Labor.

ises 100-to-1 compression or greater in the near future. Antic estimates that you will be able to contain an entire hour of real-time three-dimensional animation on a single double-sided floppy disk.

To animate, you must take a Super View picture of your scene, save it, modify the scene, change it, and take another picture. Each picture you save is a single frame in the animation. Thus, producing complex animation can be time-consuming and tedious; however, the results are excellent. By using CAD-3D's tricks, you can zoom in and out of scenes, change lighting effects, add and subtract figures, and produce complex movement of various kinds.

What Makes CAD-3D Special

Antic has already released into the public domain several disks of three-dimensional figures. Antic also promises a number of other related programs and image collections for early 1987. Liquid-crystal-shutter three-dimensional glasses developed by Tektronix will be available from Antic in early 1987 for use with CAD-3D. I've seen both still and animated scenes using the glasses, and the effect is amazing. In a darkened room, you would swear that objects float five or six inches in front of the monitor screen. [Editor's note: *At press time, Antic planned to release CAD-3D 2.0 in early 1987. The new version will include an icon interface, integer math for real-time processing, and dimensioning capabilities. It will be bundled with an animation language and will cost $89.95.*]

A Bargain

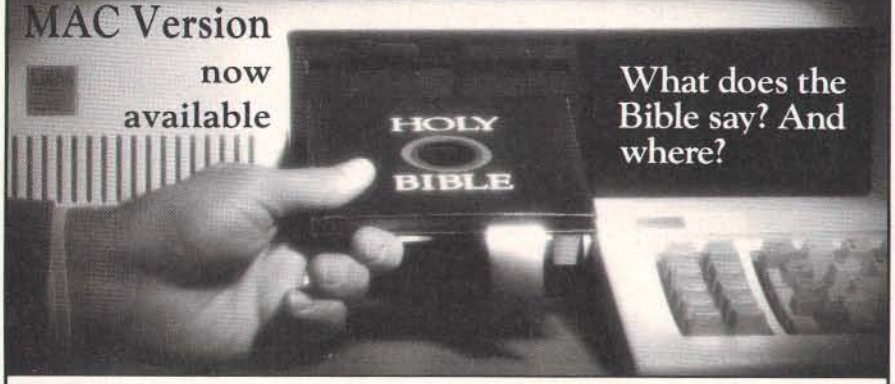
CAD-3D is an impressive program for creating, manipulating, and animating three-dimensional graphics. It lacks some of the abilities of other CAD programs, namely autodimensioning and labeling. Therefore, it is more appropriate as a design and animation tool than as a drafting tool. Also, you can't create the outline of an object in all three dimensions. To achieve complete control, you must use the Join command. Extrude allows you to create asymmetrical objects, but you can control only two dimensions. Finally, the manual is adequate but not as impressive as the program. Some additional tutorials might be useful to people new to three-dimensional modeling.

Whether you want to send pictures to two-dimensional paint programs like NEOchrome or DEGAS, print pictures out on a printer or plotter, or use the growing number of available animation tools, you should find CAD-3D an excellent program. At $49.95, it is a bargain. ■

Rusel DeMaria (109 Akea Place, Kula, HI 96790) is a freelance writer and computer consultant.

Still Searching?

MAC Version now available



What does the Bible say? And where?

We offer an integrated family of software products that allow you to search the Bible as never before.

With "THE WORD Processor" software (which includes the complete text of the KJV or NIV Bible) you can create indexes on key words, phrases, even concepts, as well as search, display or print, for just $199.95. Greek and Hebrew Transliterator products which include Strong's Concordance are also available. Or choose from a host of other exciting Biblical software products available in varying price ranges.

So if you're still searching, give us a call. We're anxious to show you how your PC can help you access your Bible as never before.

Include $3.00 for postage and handling. For Apple, IBM PC, Commodore 64, TRS80, MacIntosh, CPM 2.2, MS-DOS.

BIBLE RESEARCH SYSTEMS

2013 Wells Branch Parkway, Suite 304
Austin, Texas 78728 **(512) 251-7541**



FOCUS Computers

DO IT YOURSELF $PECIALS

64K CHIPS	9/$12.95
256K CHIPS	$2.99ea.
8087-3 INTEL	$116.50
8087-2 INTEL	$177.90
80287-6 INTEL	$177.50
80287-8 INTEL	$288.50
20 MEG HARD DRIVE	$399.50
20 MEG HARD CARD	$629.95
40 MEG HARD DRIVE	$749.50
10 MEG HARD CARD	$439.95

• COMPUTERS •

SHARP PC 7000
Lightweight transportable that's also a desktop **LOW LOW LOW PRICE!**

AT&T The right choice
6300 COMPLETE SYSTEMS WITH NEW EGA COMPATIBLE BIOS WITH 640K MEMORY, 10 MEG DRIVE, FLOPPY DRIVE, MONITOR, KEYBOARD. **WE HAVE THE BEST $PRICE$**

IBM AT & XT PACKAGES
WITH THE LOWEST PRICES

APPLE COMPUTERS
APPLE IIC ..... CALL
MAC 512K/ENHANCED $1278
MAC PLUS $1649

SPERRY
SPERRY IT W/40 MEG ..... LOW
SPERRY MICRO W/20 MEG ..... CALL

COMPAQ
COMPAQ PORTABLE 256K WITH FLOPPY & 20 MB DRIVE ..... LOW
COMPAQ PORTABLE II MODEL 4 WITH 80286 PROCESSOR AND 20 MEG DRIVE ..... CALL

PANASONIC
FX600 WITH 8086, 256K FLOPPY AND 20 MEG DRIVE $1088
SR. PARTNER ..... CALL

• MODEMS •

Hayes Smartmodem 1200B/IBM 299.95
Hayes Smartmodem 300 ..... 124.95
Hayes Smartmodem 2400/RS 232 ..... 549.95
Hayes Micromodem IIe/Smartcom 129.95
Hayes Smartmodem IIc (Apple) with Smartmodem software 149.95
Amazing Modems 1200 Baud internal with software 98.45
Amazing Modems 2400 Baud internal with software 196.95

• MONITORS •

Magnavox 13" RGB/Composite with green text switch 199.50
Magnavox RGB Ultra hi res 640 x 240 with green text switch IBM compat. 268.50
Amdek color 730 RGB/Analog/Extra hi res, PGA Compat. 749.95
AMDEK 725 AT&T compat. ..... CALL
AMDEK 310A T.T.L. (IBM) ..... CALL
NEC multi sync everything all in one monitor EGA/PGA/CGA/ **NEW LOW**
Princeton Graphics HX12 hi res color RGB 398.95

• PRINTERS •

PANASONIC (2 year warranty)
KXP 1080i NLQ faster (120 cps) 188.50
KXP 1091i top rated (160 cps) 239.50
KXP 1595 15" carr. (240 cps) 529.95
EPSON
EPSON EX1000 (300 cps) Heavy duty design 529.50
LX86 **New** (120 cps) 232.50
NEC
3550 Spinwriter LQ 789.95
OKIDATA
OKI 292 200 cps NLQ ..... **LOW PRICE**
TOSHIBA
TOSHIBA P321 ..... 429.50
TOSHIBA P341 ..... 572.50
BROTHER
M1509 Serial/Parallel Dot matrix NLQ 358.95

• LAP TOP COMPUTERS •

ZENITH data systems
Z171 Laptop IBM compatible with dual 5¼" disk drives 1288.50
Z181 Super Lightweight Laptop with 640K with 3½" pop up floppys and many more features
$We Have the Lowest Price$

TOSHIBA
T1100 Plus weighs under 10 lbs., yet has an 80C86 16-bit processor and 640K to run twice as fast as many other PCs **CALL**

Focus Computers, 1303 46th St., Brooklyn, N.Y. Tel. (718) 871-7600. Open Mon.-Thurs. 10-7, Sun. 10-6, Fri. 10-3. Most orders shipped within 24 hours. Master Card, VISA, American Express gladly accepted. All prices in this ad reflect cash discount. New York State orders must add local sales tax. All merchandise available while supplies last. Price guaranteed subject to verifiable suppliers increases. Money back guarantee if returned within 14 days in mint condition with all papers and packing material intact. No returns accepted on open software.

Call Toll Free
1-800-223-3411

Why Are So Many People Switching to Smalltalk/V?

Why are scientists, engineers, and professionals switching to Smalltalk/V? Because it lets them do amazing things on their PCs, with a Mac-like interface and an easy-to-use object-oriented language. And with Smalltalk/V you get an unsurpassed array of problem-solving tools. You can even personalize the entire system to suit your needs.

Smalltalk/V is the programmable environment that gives you total control of your computer and makes it what it was meant to be, a truly personal tool for your mind.



$99.00

"This is the real thing, folks. A super Smalltalk like this turns your PC into a hot workstation. It's fantastic . . . Highly recommended."

John C. Dvorak, Contributing Editor, PC Magazine

"My background is in physical chemistry, not in programming. I like Smalltalk/V because I can use objects in the computer to represent objects in the physical world."

Dr. Paul Soper, Senior Specialist E. I. du Pont de Nemours & Co.

"Smalltalk/V is a productive programming environment that allows us to quickly develop sophisticated medical applications."

Dr. Mike McCoy, Dean for Instructional Computing UCLA School of Medicine

Smalltalk/V

The Programmable Environment

"Smalltalk/V, with its visual interface and class structure, is a perfect way to simulate the complex interactions of natural systems."

Lee A. Graham, Research Assistant Institute of Ecology, University of Georgia

"I solve problems quickly using Smalltalk/V because its classes and objects help me organize my thinking. And besides, it's fun to use."

Dr. Barry Fishman, Sr. Project Engineer Hughes Aircraft Company

"Smalltalk/V is the highest performance object-oriented programming system available for PCs."

Dr. Piero Scaruffi, Chief Scientist, Olivetti Artificial Intelligence Center

"Smalltalk/V is an excellent buy and makes a good alternative to other programming languages for the development of complex applications."

Bill Wong, Director, PC Labs PC Magazine

Other Smalltalk/V Features

- Object-oriented Prolog integrated with the Smalltalk environment
- Supports exploratory programming and prototyping
- Class hierarchy with inheritance creates highly re-useable source code
- Smalltalk source code included, with browser windows for easy access and modification
- Object-swapping creates a virtual memory on hard or RAM disk
- Bit-mapped graphics with bit and form editors
- A sophisticated source-level debugger
- Automatic change log for easy recovery from errors
- Powerful directory/file browser system for organizing DOS files
- Access to other languages and DOS functions
- 500 page manual with comprehensive tutorial and reference sections
- Optional add-on modules
  - RS-232 communications interface with UNIX™ and TTY windows
  - EGA color graphics
  - "Goodies" diskette, including multiprocessing, music, zoom, object loader, and more

Inquiry 88

BYTE and BIX are trademarks of McGraw-Hill, Inc. IBM, IBM-PC, and IBM PC-AT are trademarks of International Business Machines Corporation. Unix is a trademark of Bell Laboratories.

Yes! I want to turn my PC into a hot workstation! Send me . . . .

☐ Smalltalk/V-The Programmable Environment	$99
☐ Communications Option	$49
☐ EGA Color Option	$49
☐ "Goodies" diskette	$49
Shipping and Handling	$____
CA residents add applicable sales tax	$____
TOTAL	$____

Shipping and Handling

U.S., Canada, Mexico	$ 5.00
Elsewhere	$15.00

I enclose ☐ Check ☐ Money Order

☐ Credit card information ☐ MC ☐ VISA

Number:_____

Expiration:_____

Signature:_____

Name:_____

Street Address:_____

City/State/Zip:_____

Phone:_____

NOT COPY PROTECTED, 60-DAY MONEY-BACK GUARANTEE
ON-LINE USER-SUPPORT CONFERENCE ON BYTE'S BIX™

Smalltalk/V requires DOS and 512K RAM on IBM PCs (including AT) or "compatibles," and a CGA, EGA, Toshiba T3100, Hercules, or AT&T 6300 graphic controller. A Microsoft or compatible mouse is recommended.

digitalk inc.

5200 West Century Boulevard
Los Angeles, CA 90045 (213) 645-1082

REVIEW FEEDBACK

Western AT

I was pleased to see the Western AT reviewed in "Four IBM PC AT Clones" by Wayne Rash Jr. in the December 1986 BYTE. However, I was disappointed that you could not accept our 8-/10-MHz machine for review, which we have been shipping since last summer. We no longer ship the 6-/8-MHz unit and have not increased the price for the faster machine. The review does not mention this, and we feel a bit like a David without his slingshot.

Mr. Rash states that the Zenith Z-248 is "the obvious front-runner" and that "this machine is significantly faster than the competition." Neither of these statements is supported by the charts on page 241. Our Western AT actually beat the Z-248 in the 40K File Copy test by 0.6 second and was faster in both the Write and Read tests for Disk Access in BASIC by 1 second. Mr. Rash also commented on the quality of our front-panel lock, yet it is the same lock used by IBM.

We did photocopy our user's manual back in January 1986 when we first sent the review machine. We perhaps should have sent the completed new manual. Yet Mr. Rash did not have any problem using the documentation.

Finally, Mr. Rash does not know us and apparently is quite familiar with Zenith. We have no service complaints from our customers anywhere in the world. His speculation about our service seems out of context.

Earl Perera
President, Western Computer
Irvine, CA

We regret that we were unable to evaluate Western's 8-/10-MHz computer along with the 6-/8-MHz model. However, when the 8-/10-MHz machine was delivered, a letter accompanying the computer said the unit "will be FCC Class A and B approved," which implied that the unit had not received FCC approval at the time and therefore was not yet being shipped. As a matter of policy, BYTE does not review products that are not shipping.

Regarding Western's service, a spokesman for the company told us that Western has no dealers in Washington, D.C., and only two dealers east of the Mississippi. Also, although Western pays shipping charges when returning a serviced computer, the customer must pay the charges for shipping the computer to Western. We think, therefore, that Mr. Rash was fair when he stated that Western's service is limited.

Cathryn Baskin
Senior Technical Editor, Reviews

23 Modems

The review entitled "23 Modems" by Stephen Satchell (December 1986 BYTE) contains several procedural errors. The primary fault is a misunderstanding of parameters that affect performance. The most troublesome impairment encountered by modems on a telephone circuit is nonlinearity of the channel-transfer function, yet this was not mentioned.

Frequency offset is another common impairment that was omitted. Frequency offset is a shift in the carrier frequency caused by frequency-shift multiplexing and is often found on common carriers.

The test parameters themselves are suspect. For example, engineers measure modem sensitivity in dBm—not in dB, which is merely a ratio. One must specify a basis for a ratio in order to convey information.

The White Noise measurements are similarly suspect. A good 300-bps modem can handle a 3-dB signal-to-noise ratio; at 1200 bps, about 11 dB; at 2400 bps, perhaps 15 dB, for an error rate of 1 bit in 10^5, assuming no other impairments.

The Phase Hit test must be a mistake. No 1200-bps modem can survive a 150-degree phase hit; a 45-degree phase hit will force an error using the 212 modulation scheme. A good 212 can take about 35 degrees of phase jitter, while a 2400-bps modem might accept 20 degrees (again, assuming no other impairments). The Gain Hit test is also suspect; I doubt that a 1200-bps modem could sustain a 20-dB gain hit without error; a 2400-bps modem certainly cannot. In practice, observed phase jitter is less than 7 degrees.

A good modem evaluation must be traceable and reproducible. Mr. Satchell mentions using three signal levels and "a great deal of filtering" at −5 dBm. What does this mean? The FCC standard for modem transmitter output is −9 dBm, so a modem evaluation based on a −5-dBm input signal would hardly reflect the signal levels seen on a real call (perhaps −20 to −40 dBm).

James Nichols
San Mateo, CA

The Bradley 2A/2B line simulator is capable of second- and third-order harmonic distortion up to 15 percent. Only the Kyocera KM1200S showed sensitivity, being able to withstand 15 percent of second, third, and combined distortion without error. On page 260 you will note that in the Error Count test, 2 percent of second and third harmonic distortion was set up on the 2A/2B.

The 2A/2B is also capable of generating a frequency offset of plus or minus 10 Hz. No modem was affected by a steady-state frequency offset. When I switched the shifter in and out, all the modems were affected, even with a frequency offset of zero. I used no frequency shift in the Error Count test.

All sensitivity figures are referenced to a level of −5 dBm. In the tables, a value of 30 indicates that the lowest level the modem responded to without error was −35 dBm; a value of 40 indicates −45 dBm.

The White Noise figures are absolute output levels in dBrn (1 dBrn is equivalent to −90 dBm) before attenuation. The signal output level is −5 dBm, or 85 dBrn.

The Bradley 2A/2B can also define a ramp for both phase- and amplitude-hit impairments. I ran two test series, one with a 20-millisecond ramp and another with a 2-ms ramp from 0 degrees to the test value and from the test value back to 0 degrees. The spread reflects this test setup. In the future, I will add a much steeper ramp for drop-out testing to reflect some real-world drop-out conditions I was not aware of at the time I performed the tests.

The three levels I used were −5 dBm, −15 dBm, and −25 dBm. Since I've run into problems with modems that could not take a "hot" signal such as you would get with a PABX, I wanted to "smoke out" those with insufficient headroom. According to the Bell connection study, a 20-dB or larger loss at 1004 Hz was reported in less than 10 percent of the long-distance connections, and a 10-dB or greater loss was reported for 95 percent of the long-distance connections. The worst modem of the bunch required a signal stronger than −37 dBm to function at 300 bps; the best required −47 dBm. I did a test run at −35 dBm and was plagued with disconnects, so I elected to run at higher levels.

Stephen Satchell ■

REVIEW FEEDBACK is a column of readers' letters. We welcome responses that support or challenge BYTE reviews. Send letters to Review Feedback, BYTE Publications, One Phoenix Mill Lane, Peterborough, NH 03458. Name and address must be on all letters.

The Best Monitor Solution

TAXAN'S NEW MULTIVISION 770 OUT-SCANS THE COMPETITION. COMPARE.

TAXAN introduces the first multiscan monitor that automatically adjusts to scanning frequencies in both HORIZONTAL and VERTICAL directions – with almost any color card on the market! The new TAXAN MultiVision 770.

The horizontal scanning automatically switches from 15 to 35 Khz, while the vertical scanning frequency automatically adjusts from a broad range of 50 to 90 Hz. It delivers unmatched versatility to meet all your application needs – now, and in the future.

The only color monitor you'll ever need.

TAXAN's MultiVision 770 offers the best across-the-board compatibility with three of the most popular graphics modes: CGA, EGA, and PGA. Compare.

TAXAN "out-scans" the competition.

	Taxan MultiVision	NEC MultiSync
IBM COMPATIBILITY	YES	YES
HORIZONTAL FREQ VARIABLE	YES	YES
VERTICAL FREQ VARIABLE	YES (AUTOMATICALLY)	NO
RESOLUTION	800 x 600	800 x 560
DISPLAY AREA	AUTOMATICALLY ADJUSTS FOR FULL SCREEN DISPLAY	VARIES WITH USE REQUIRING ADJUSTMENT

Text, Charts, Graphs, and CAD/CAM in one.

TAXAN's MultiVision offers a maximum 800 x 600 lines of outstanding resolution. This Ultra-High Resolution capability combined with the .31 mm dot pitch and special full screen "over-scan" switch delivers clear, sharp images for text, chart, and CAD/CAM applications. All on a 14" TAXAN special non-glare screen.

Best price, quality, and versatility ever.

It's here today. Complete with the flexibility to expand your needs into the future. Stop by your nearest authorized TAXAN dealer to see a full text, business graphics and CAD/CAM demonstration of TAXAN's exciting new MultiVision 770.

Compare the only monitor that "out-scans" the competition.

MULTIVISION 770

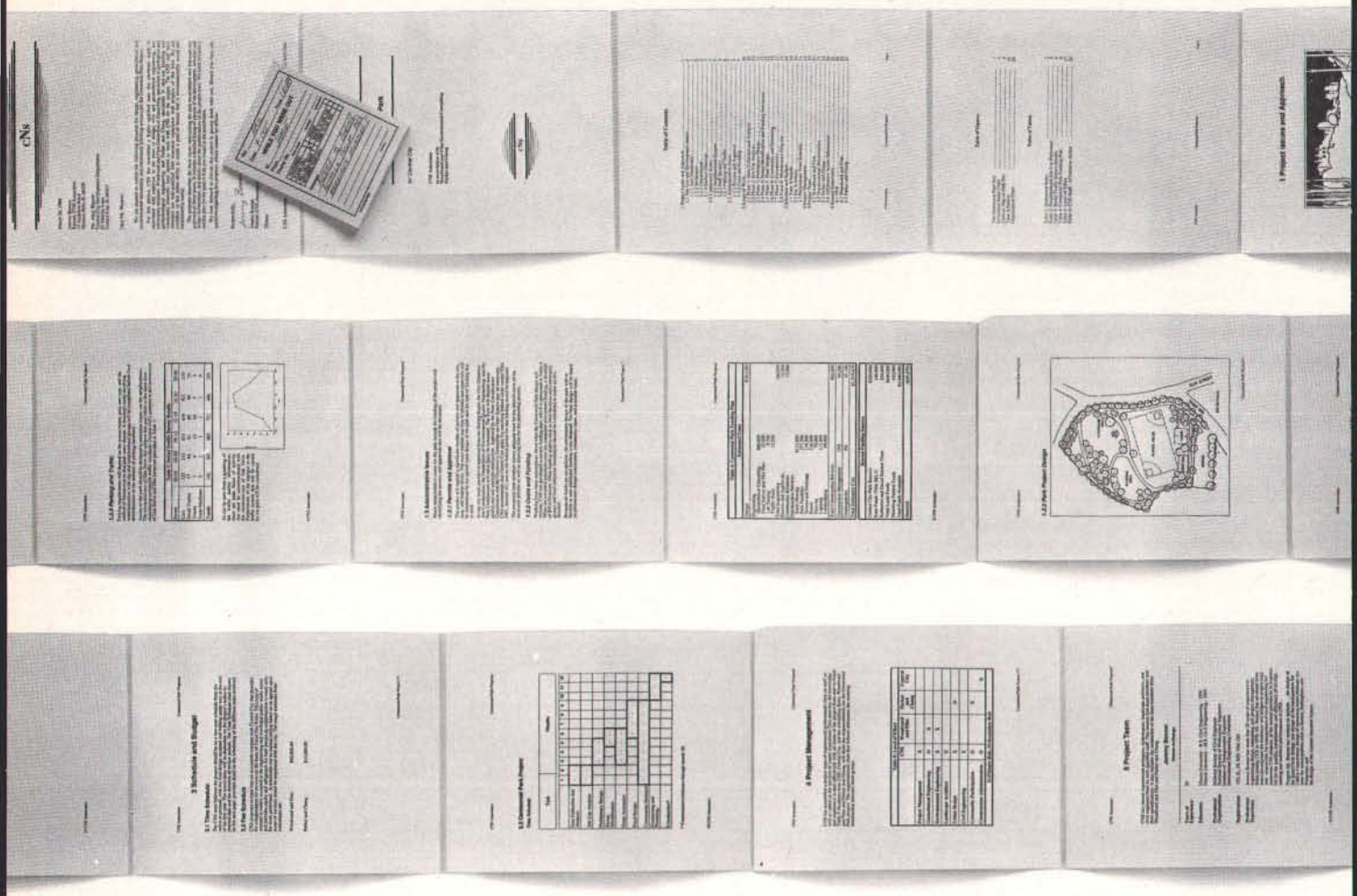


TAXAN

TAXAN USA CORPORATION, 18005 Courtney Court, City of Industry, CA 91748. (818) 810-1291

Inquiry 298

How to process docum



You may be content with your present word processor. And it's easy to understand why.

Even the clumsiest word processor is light years beyond the electric typewriter, the accepted standard only a decade ago. Plus, just the term word processing conjures up a rather modest expectation, ho hum, the ability to process words.

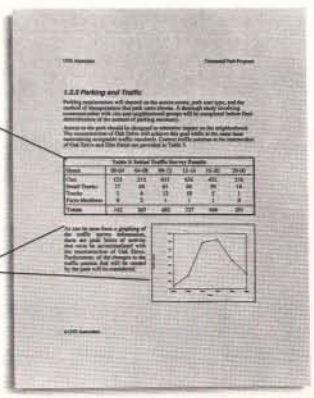
But, the mere processsing of words is hardly the challenge today. When you're creating a 20-page report, an 80-page proposal, a 200-page specification, or just a 2-page letter, you often have to work with graphics, equations, tables and more.

That's simply too much to ask of a product designed to process words. But, that's exactly what you can expect from Lotus Manuscript,™ a word processor that is truly a complete document creation system for technical professionals.

Very often documents require the mixing of text and graphics on the same page, graphics from Lotus® 1-2-3,® Symphony® and Freelance® Plus. With Manuscript you can import spreadsheets and charts, as well as diagrams and scanned images.

Spreadsheets, graphs and charts for 1-2-3® and Symphony® can easily be mixed with text on the same page.

You can throw away your scissors and glue, cut and paste are a thing of the past.

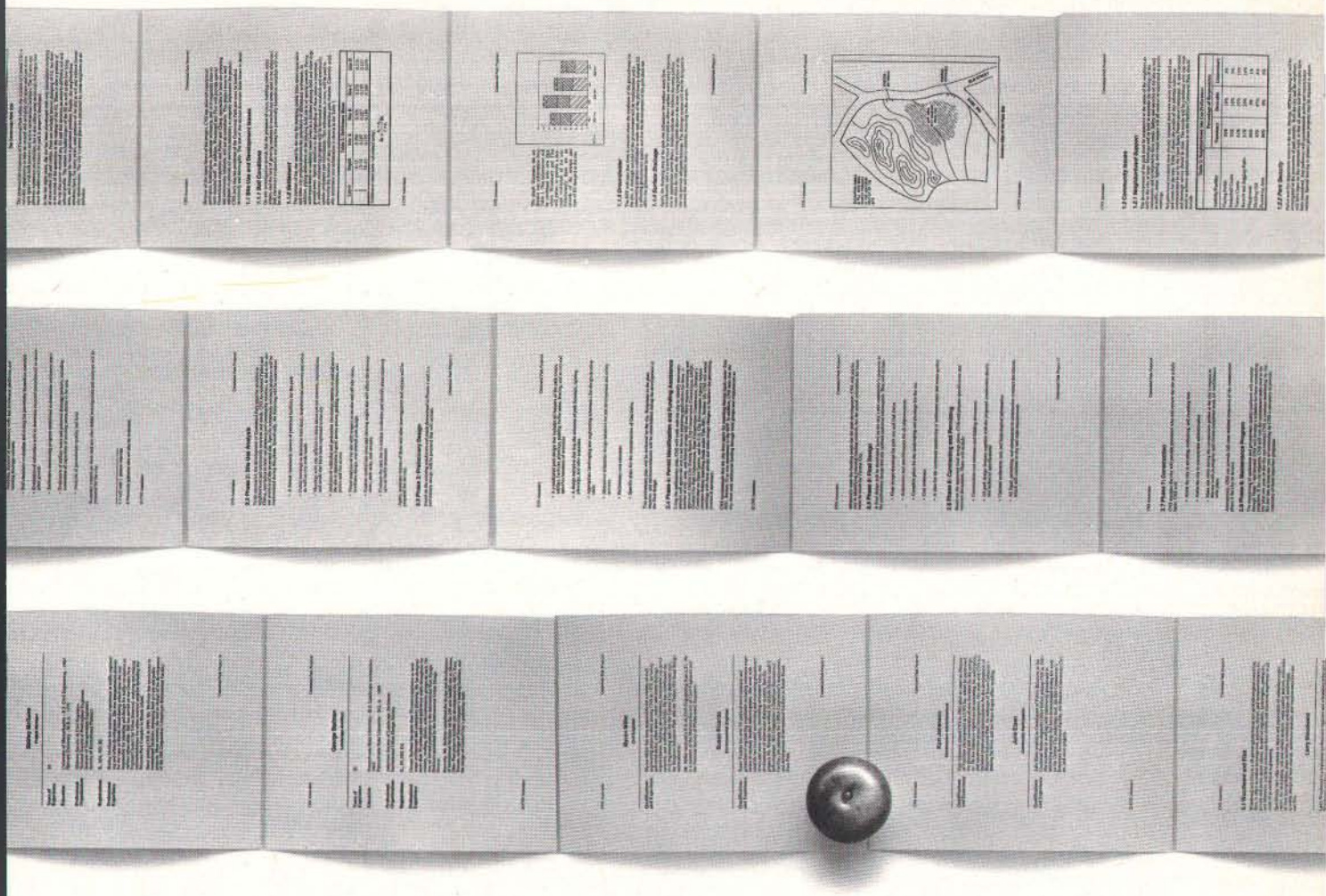


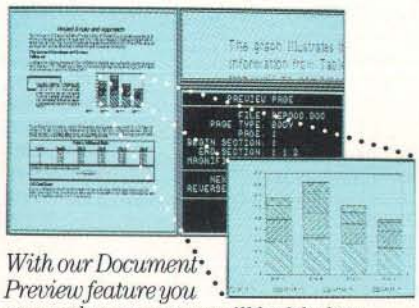
Another feature that goes beyond conventional word processing is Manuscript's integrated Outliner. When you collapse the document you're able to navigate the outline much easier than wading through the entire piece. You can move a page, or even an entire chapter with just a few keystrokes.

Because Manuscript understands the structure of your document, you can globally format an entire document or format by individual sections. Imagine changing all headlines from 14 point plain text to 16 point bold, by a simple menu selection.

Manuscript's Document Com-

ents instead of words.





With our Document Preview feature you can see how any page will look before it's printed. Zoom capability lets you take a closer look at graphics and equations.

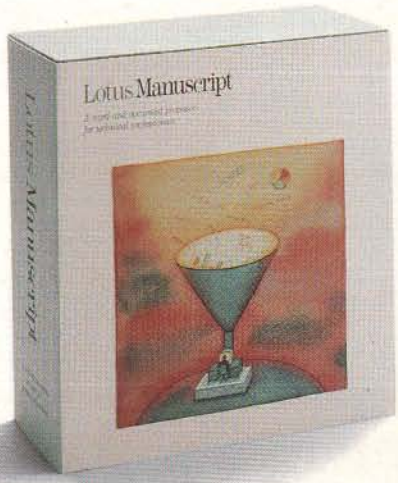
pare feature highlights changes between revisions for fool proof proof-reading.

Also, Manuscript automatically sizes and generates math equations as well as upper and lower case Greek symbols, diacritical marks and brackets.

With our powerful Print Formatter you have complete control over the look of your document, from position and size of graphics, to fonts and point sizes and more.

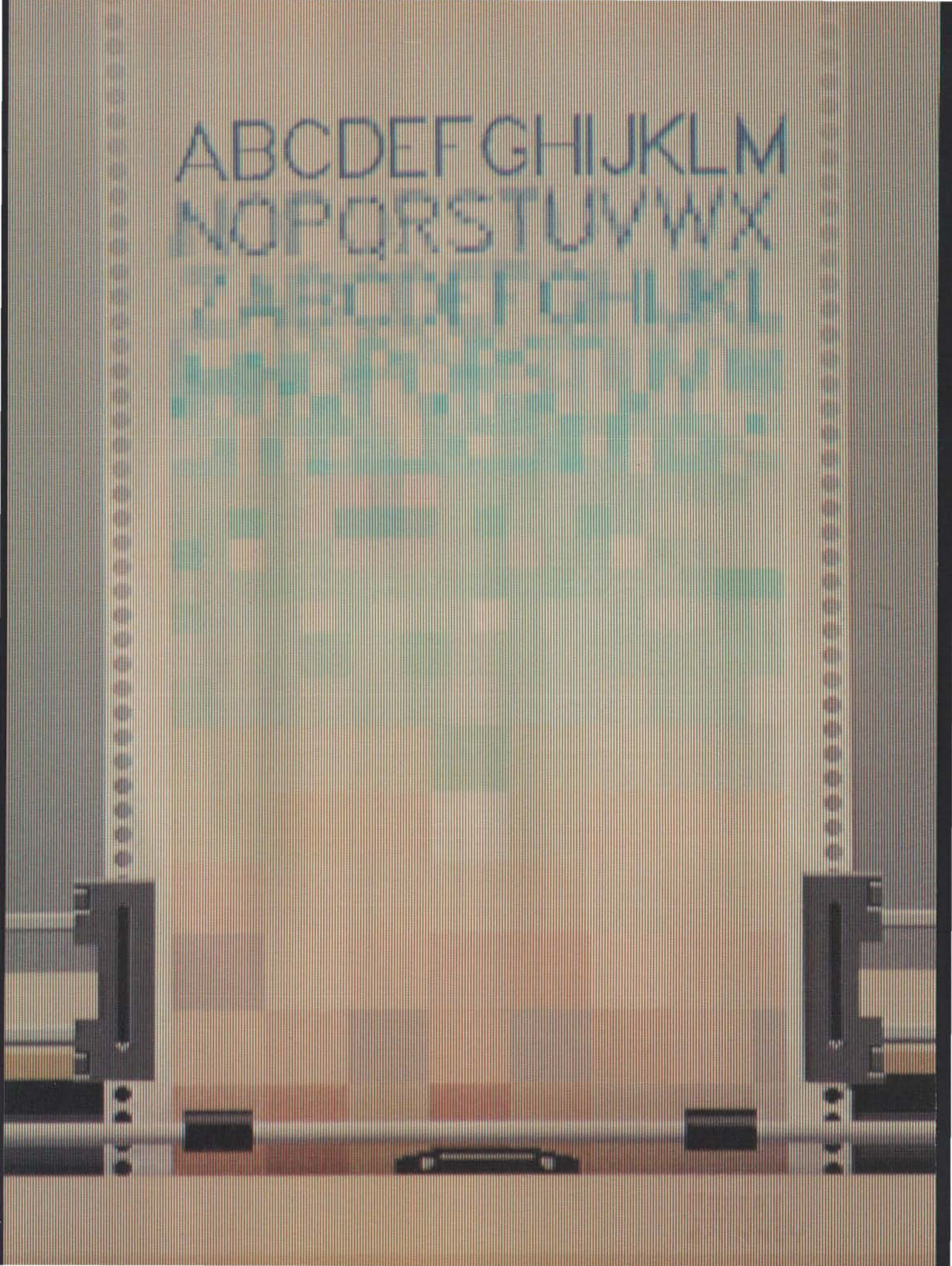
As for the quality of output, Manuscript takes full advantage of today's printing technology, from dot-matrix to laser, including PostScript® printers.

Manuscript is designed to work on most IBM® PCs and compatibles.* Its familiar 1-2-3 interface makes it easy to use. And our Manuscript evaluation kit makes it easy to try. For $10.00, you'll get a presentation disk, working software, and a tutorial manual. To get your evaluation kit, call 1-800-345-1043, ask for lot #YD-1450. Or, for more information, see your authorized Lotus Dealer, or write Lotus Development Corp., 55 Cambridge Parkway, Cambridge, MA 02142.



Lotus Manuscript™

© 1986 Lotus Development Corporation, Lotus, 1-2-3, Symphony and Freelance are registered trademarks and Lotus Manuscript is a trademark of Lotus Development Corporation. PostScript is a registered trademark of Adobe Systems, Inc. IBM is a registered trademark of International Business Machines.
*Manuscript and Manuscript Evaluation Kit require 512K and a hard disk.


ABCDEFGHIJKLM
NOPQRSTUVWX

Kernel

Computing at Chaos Manor:
The Curse of Chaos Manor
by Jerry Pournelle 251

Applications Only: Status Report
by Ezra Shapiro 271

BYTE U.K.: Taking Control
by Dick Pountain 279

According to Webster:
Amiga Developers Conference
by Bruce Webster 291

PROBLEMS WITH HIS COMPUTERS, a large number of deadlines to meet, and traveling to COMDEX and Europe caused Jerry Pournelle to have an especially chaotic month. Jerry, alas, didn't make all his deadlines. The basic reason for this is that his computers let him down. The Golem was away being fixed, Big Kat had a bad chip on the controller board, and Zebediah had communication problems. All this forced Jerry to be resourceful in finding ways to get his writing done. He did some of it working in the pressroom at COMDEX. Jerry describes this process, says more about WordPerfect, and mentions what he found of interest at COMDEX.

Ezra Shapiro's Applications Only column is slightly different this month. While he does look at a couple of new products—Ragtime and Write Now—Ezra also includes two sections of true confessions. Don't worry, this won't be anything like the *National Enquirer*. Ezra's confessions deal with the products, both software and hardware, he uses regularly. Since personal work habits affect program evaluations far more than writers usually care to admit, Ezra hopes that if readers know what he likes, they'll have a better chance of determining how his preferences match up with their own.

Abraham Lincoln once wrote, "I claim not to have controlled events, but confess plainly that events have controlled me." It seems that for most of us this often turns out to be true. Yet taking control is something we are constantly seeking to do. Dick Pountain considers the theme of control in another sense. He has recently been playing with three systems that let a microcomputer control events in the real world: the Scorpion controller from Micro-Robotics Ltd., a robot arm called RTX from Universal Machine Intelligence Ltd., and a FORTH development system called Martello from British Telecom. What's important to Dick as a software person is that all three use a high-level language to achieve their control.

As can be gleaned from the title of According to Webster, most of Bruce's column is devoted to the Amiga. While he was at the Developers Conference, Bruce met representatives of many companies that are developing products for the Amiga. He was able to take home and test two such products: the StarBoard II, a memory-expansion box from MicroBotics, and Marauder II, a disk backup program from Discovery Software International. Two other products Bruce saw at DevCon were ProWrite, an Amiga word processor, and DigiView, which lets you hook up a television camera to your Amiga and produce hold-and-modify images. Bruce also reviews four books for the Amiga and discusses his COMDEX trip.

CONNECT.



OCR SCANNING

Our "SCANNING CONNECTION" system can be used to read your paper documents into a PC. Pictures and graphs can be scanned and saved in various file formats for use by many word processing and desktop publishing systems. Text images can be converted to character text for use with most word processing and typesetting systems. Images can be sent over telephone lines to another PC or a facsimile machine.

We have developed a special controller card for high speed compression of images and for character recognition. Books, magazines, newsprint, reports and typed documents can be read by our OCR software. The software can be trained to recognize almost any font style. System prices including scanner and software start at $1795.

9-TRACK TAPE

With our "TAPE CONNECTION" system you can read and write most 1/2" 9-Track magnetic tapes using your PC. Tapes can be 800, 1600, or 6250. Our file transfer software can process ANSI labeled tapes from most computer systems including DEC, HP, HONEYWELL, and IBM. Large files from multivolume tape reels can be transferred to a disk at rates up to 5 MB/min. Software is provided to use the system for backup of the hard disk on your PC.

With more than twenty years experience in working with tape drive systems, we can solve most PC tape conversion problems. We can supply more than ten different tape drive models. System prices including tape drive, controller card, and software start at $3495.

DISKETTE CONVERSION

We specialize in conversion systems and can transport your documents or images to almost any computer, word processing, or typesetting system. With our "DISKETTE CONNECTION" system you can read and write most 8", 5¼", or 3½" diskettes using your PC. We support systems from DEC, CPT, WANG, NBI, LANIER, HONEYWELL, and XEROX. We support most IBM systems including 3741, S/36, PC/36, 4300, and Displaywriter.

Since 1981 we have developed hundreds of software programs and designed many specialized diskette hardware products. With thousands of installations worldwide, we are probably the world leader in manufacturing diskette conversion systems. System prices including diskette drive, controller card, and software start at $1195.

FLAGSTAFF ENGINEERING

Inquiry 110 for End-Users.
Inquiry 111 for DEALERS ONLY.

1120 Kaibab • Flagstaff, AZ 86001 • 602-779-3341
Compusol-Europe • 12 Rue Rosenwald • 75015 Paris • Tel 530.07.37 • Telex 205431F

The Curse of Chaos Manor

Jerry Pournelle

This month has been hectic. It started with deadlines: I've got rather far behind on noncomputer works lately, and this month they all caught up with me. By month's end I was supposed to turn in an anthology; a novel; *Strategy of Technology*; this column and two others; an article for *Reason* magazine about the imbecilic decisions the United States Department of Commerce made in setting up a U.S.-sponsored cartel in computer memory chips; and the usual administrative stuff, including keeping up with my BIX conferences and going over the copy-edited manuscript for *The Legacy of Heorot*, which will come out next summer from Simon and Schuster.

With Golem gone, Big Kat down, and Zeb not talking, what's a man to do?

If that weren't enough, COMDEX was on during the second week of the month, and I had to go to France and England the day after I got back from COMDEX.

I didn't make all my deadlines. I might have, if my computers hadn't let me down.

Golem Problems

Actually, only one machine failed; but three aren't working.

First there's the Golem, my big CompuPro 286/Z80. Last month we took him up to Viasyn's CompuPro headquarters in Hayward, where they did a full retrofit. When it came time to test it, the hard disk wasn't within spec.

CompuPro tests stuff thoroughly. I've been in their burn-in room: it's an insulated room full of components being exercised. I don't know the exact temperature in there, but it's above 100° Fahrenheit. They also test disk drives with voltages plus and minus 10 percent of rating (they guarantee plus or minus 5 percent), and mine had intermittent read errors under heat and high voltage, so Dr. Godbout decided to replace it with a drive system they're thinking of incorporating into the new CompuPro line. (One reason they're so nice to me is that I'm a guinea pig for new stuff: I *use* equipment here, and if it's going to break down, I'll probably manage to do it eventually.)

Meanwhile, I'd had to pay the bills. This is a big deal around Chaos Manor as my life is pretty complex. I've evolved a ritual. As bills come in, they go into an alphabetized folder. Come the end of the month, I make a big pitcher of vermouth cassis and seltzer, fire up the Golem, and bring up the accounting program I wrote back in 1978.

There's a story that goes with that.

I get a *lot* of computer programs. I don't suppose there is one major program out there that I don't have. Not one of them seems suitable for keeping track of my life. It isn't that the money manager programs can't balance my checkbook and watch out for my bank accounts: it's that they're so darned hard to get the data into. When I wrote my accounting system program, I set it up to take as large a chart of accounts as I would want (currently about 300 ledger pages); to know the difference between "family" expenditures that are not deductible and business expenditures that are; and to have the simplest possible entry interface. The result is a journal that looks a lot like the old accounting journals you see illustrated in textbooks. Each entry has a "To" showing where the money went; a ledger page entry representing the account (checking, savings, American Express, Bankamericard, etc.) from which the money was paid; a page number to show what kind of expense (entertainment, supplies, travel, family accounts, etc.); and an "explanation" intended largely to show a tax examiner why this was a legitimate expense (if it was a business expense).

Better than that, every month the program offers me the opportunity to write checks to everyone I ever write checks to. If I hit Return, it keeps the amount I paid last month; otherwise, I can fill in a new amount. When I'm done the program writes those checks with the current date, unless I've entered an amount of 0, in which case it skips that check. The whole thing saves no end of time, since I enter that data once and once only. While I'm at it, I go through the monthly credit card entries and put them in the journal. Then I list the deposits and the checks we wrote by hand during the month; and if I've been on trips or otherwise spent deductible cash, I get that in. The procedure takes about four hours, but when I'm done I'm finished with it, after which the computer makes up ledgers, balances the accounts, and in general digests the data; and I won't have to fool with it again until the end of the year when I do my taxes, and in fact I don't have to do much then.

I've never seen a commercial program that could do all that, so I stick with mine. (Incidentally, mine is available for CP/M or PC-DOS from Workman and Associates. The program works, but the documents aren't very good. I didn't write the program for other people, and I didn't put in enough examples when I tried to explain it.)

There was one problem with paying the bills: I normally use that program with the Golem, and the Golem was in Hayward.

Time to fall back on something else. The obvious course would be to use a PC version, but the problem there is I keep my accounts on 8-inch disks (I trust 8-inch disks a *lot* more than I trust 5¼-inch disks), and I have no PCompatible that knows how to read 8-inch disks. The only 8-inch drives are on the Golem and on Zeke, the ancient CompuPro Z80 I use to write most of my books.

continued

Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future.

What the heck, I thought, when I wrote that program Zeke was the only computer I had. He'll run it fine.

He did, too. Of course, he's much slower than the Golem, but I ran everything off Zeke's CompuPro M-Drive/H (RAM disk cards: if you're trying to live with a CP/M system you'd *better* have a RAM disk; my CompuPro M-Drive/H cards have given trouble-free service for seven years now). Since the slowest part of my program is disk access, speed wasn't a real problem.

Memory was a problem: the CompuPro 286/Z80 system under Concurrent CP/M has much more available working memory than a normal CP/M system; and I had redimensioned the arrays in my accounting program to take advantage of that. Naturally I forgot that, put in too many entries, and got an "Out of memory" error. Fortunately I save early and often so I didn't lose much work, and all I had to do was break things into smaller chunks.

Came time to print the checks.

That presented a problem: the checks are on a tractor feed, and thus can be printed only with my NEC Spinwriter.

THE ALTERNATIVE!

SAM 3001 AT

PC Magazine, Editor's Choice



640K RAM, 6/8 MHZ, 1.2M FDD, F/H Disk Controller, 2 Serial Ports, Hi-Res RGB Board w/PP., 195W Power Unit & Keyboard. Monitor extra. Compatibility Guaranteed. FCC/VDE Certified. U.S. origin.

HiTech International, Inc. A KNK COMPANY

Order Desk
(800) 538-8157 National
(800) 672-3470 California
Ask for Dept. 864

1435 McCandless Drive
Milpitas, CA 95035
(408) 263-3300
TLX 501422 HIT

Copenhagen 242 54 10 · London 01 640 9130 · Nürnberg 0911 333923 · Paris (1) 45974529

SAM 3001 AT is a trademark of HiTech International Inc.

There was a time when my regular printer was the NEC Spinwriter 7710. That printer still works, but the HP LaserJet Plus is so much faster and nicer that it does all the upstairs printing work. (The downstairs printing is done with the BDS Model 630/8 laser printer, which has become permanently attached to Mrs. Pournelle's machines.) In particular, Zeke talks to the HP LaserJet at 9600 baud, and what he expects to see at the end of that line isn't really the HP: it's Applied Creative Technology's Printer Optimizer. The Optimizer can talk to the Spinwriter, of course; I've had it long enough that at one time that's exactly what it did. The Optimizer is a smart box full of memory that catches what the computer sends and feeds it off to the printer at the printer's speed. Sure it could talk to the NEC. Time to dig out the documents. Naturally I couldn't find them for a while.

About an hour later, though, the first crisis was over. My checks were printed, and my accounts were safely stored on two different 8-inch disks.

Next

The next problem was that the Golem arrived and had been damaged in shipping. He had to go back to Hayward. Sigh. That meant that anything I wrote this month to go out on a modem would have to be written on Big Kat, the Kaypro 286i PC AT work-alike; which means using WordPerfect.

That's no tragedy: I am not only getting used to WordPerfect, I have to confess I am beginning to *like* it. Many of the problems I had with the program turn out to be misunderstandings. I don't blame myself: WordPerfect's documents are confusing, or at least they are to me; but in fact I find the program relatively easy to use, which is to say some of the time it's nearly invisible. I still have trouble remembering how to do certain things, and I cannot find a command to cause the damn thing to jump to the *beginning* of a line (it does skip to end of line fine); but compared to Microsoft Word this is a wonderful program.

I suppose I'd better explain that.

My problem with Microsoft Word is that, being a touch-typist, I do not like to have to take my hands off the keyboard. Microsoft Word, on the other hand, assumes you'll use the mouse for nearly everything. Worse, it lacks a great many keystroke commands. For example, to delete something larger than a single character, you mark the word, line, or block you want to delete, then kill it. I hate that; WordPerfect has a way to delete words so that I can suck the rest of a line, or paragraph, down a black hole if I like.

continued

Inquiry 134

First new ¼ inch cartridge since 1971

Cartrex introduces the first, brand-new, ¼-inch tape cartridge technology in over 15 years for some fundamental technical reasons. . .

. . .and today's tape drive need for 400% increase in tape speed, 500% increase in track density, 1000% increase in bit densities, and 3000% increase in bits/second, are just a few. Read on to get the complete story.

Why a new cartridge

With the significant increases in tape drive capacity, system reliability demands a tighter tolerance cartridge. Most tape drive users aren't aware that all of the tensioning, tolerance, and data reliability issues are virtually all a function of the tape cartridge.

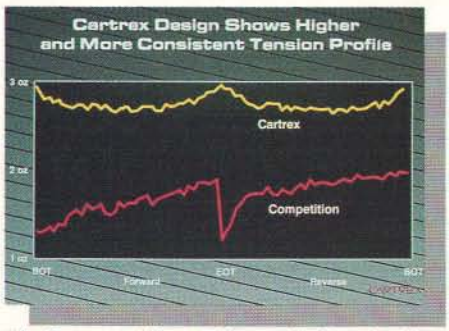
When 3M announced its cartridge in 1971, it was designed for a low capacity tape drive with less than 3 megabytes—2.88 to be exact. The tape was low in density—1600 bits per inch with only 4 tracks and 300 feet of tape.

The tolerances required for the tape drives of the early 1970's were fine for then, but today's tape drives require much tighter tolerance. Today's tape cartridges must work with drives that have 9 or more tracks and bit densities as high as 12,000 bits per inch on 600 feet of tape. That means capacity increases of 2,000 percent packed into the same cartridge.

The reasons that yesterday's cartridge technology simply won't work properly in today's high capacity drives is inherent in the cartridge design. The three culprits that make cartridge tolerances so important are fluctuating tape tension, redeposit nodules, and instantaneous speed variations (or ISV).

Tape Tension

Tape tension at the read-write head is important because the tape drive's electronics expect data to arrive at a constant rate. Consistent tape tension is a function of the cartridge tensioning mechanism. The new Cartrex cartridge tensioning design, based on a mechanical differential between two stiff belts, provides very predictable results. The historic 3M design—used by 3M and DEI—uses an elastic belt coupled with drag friction at the rear pulley to create tension. The accompanying graph shows the significant improvement the Cartrex cartridge design offers over the conventional design.



The Cartrex cartridge provides predictable and stable tension. Compare it to the tension variation of the conventional cartridge design. The consistent Cartrex tension virtually eliminates data errors and data loss from head-to-tape separation and redeposit nodules that can occur with fluctuating, low-to-high tension performance.



The new Cartrex ¼-inch tape cartridge is the first new tape cartridge design in almost a decade and a half. Tape drive manufacturers now have a new cartridge technology which allows them to advance today's and tomorrow's drive performance.

Redeposit Nodules

Redeposit nodules are the insidious flakes of tape media that break off from the edges of the tape and get dragged to the edge of the read-write head. If the tension is low, or becomes low when the tape starts or reverses, the flakes slide past the edge, get smeared across the head, and reduce its ability to read data.

The free play in the two tape reels combined with the tape guides are the primary culprits in creating these redeposit nodules. As the tape enters the guide from the tape pack, the tape guide aligns the tape by balancing the tension at the edges of the tape. Uneven edge tension not only causes media to flake off causing redeposit nodules, but data is lost due to the "coining" or "scalloping" effect.

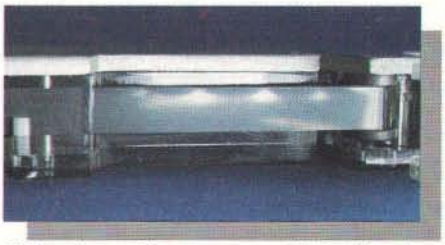
Cartrex eliminated the cause of the tape coining or scalloping with a barrel-shaped roller placed in front of the tape guide. The roller positions the tape and drops the edge tension to zero. By using this roller, the possibility of media flaking off and creating redeposit nodules is virtually eliminated.

Instantaneous Speed Variation (ISV)

Instantaneous speed variation is exactly what it sounds like—small, instantaneous changes in tape speed as it crosses the tape head. At slow tape speeds and low bit densities—like the 1971 standard of 30 inches per second and 1,600 bits per inch—ISV wasn't as big a problem. At that time, the bits were crossing the head at 48,000 bits per second.

Today, however, the story has changed. Ninety inches per second and 8,000 bits per inch mean that 720,000 bits cross the head every second. A 1,500% increase. As you may have guessed, 1971 speed fluctuations in the 48,000 bits per second range made reading data difficult for tape drive electronics. But today, when the electronics have to guess whether or not the bit rate of 720,000 bits per second is accurate, the electronics can become overwhelmed.

The Cartrex tensioning mechanism relieves the overload placed on the electronics with respect to ISV. The longitudinally stiff belts ensure tension at all times. The stiff belt overpowers variations that exist with the 3M elastic belt cartridges. The barrel roller guides, in addition to reducing the edge pressure to zero, tend to dampen out any residual ISV effects.



High speed tape seldom enters tape guides parallel to the top and bottom, even with improvements to the tape reel hub designs. The edge pressures which result create "scalloping" or "coining" on the tape. The effect is data loss due to head-to-tape separation, flaking media that smears across the head, and "redeposit nodules" that create hard errors.

Never a Single Issue

Your tape drive seldom has the luxury of dealing with an isolated problem. It's usually a combination of ISV, redeposit nodules, and tension problems all together. Now you understand why Cartrex developed a modern cartridge alternative.

Where to get it

Not only has Cartrex improved on the industry's 15 year old technology, they have done it for a competitive price.

Now you can have peace of mind when you back up your hard disk on today's sophisticated tape drives.

And you can have it fast. Simply phone and give Cartrex your purchase order number or your credit card number and they will send your cartridges by return mail.

(619) 485-6603 Ext. 2400

Dealer Inquiries Invited.

VISA MasterCard AMERICAN EXPRESS

CARTREX

CARTREX CORPORATION MARKETING HEADQUARTERS	11590 WEST BERNARDO CT SUITE 230	SAN DIEGO CALIFORNIA 92127	619-485-6603 TELEX 7101115609 FAX 619-451-3640

The first real alternative in ¼-inch tape cartridges™

That alone is worth using WordPerfect rather than Microsoft Word, because when I write I fuss with the words a *lot*. I put up sentences, fool with them, erase them, stuff in more words, kill them, and generally scribble all over the screen until it reads the way I want it to; which means I want real simple ways of killing chunks of text. WordPerfect isn't as good as WRITE that way, but it's darned good.

Rating text editors is an impossible task anyway. One person's love is another's hate. The important thing is to find one you like and learn it well. I know people who still write whole books on WordStar—not even NewWord—and I find that incredible. Ah, well.

Anyway, without the Golem I cannot transfer anything from Zeke to Big Kat, and Big Kat has the communications systems.

At that point Big Kat died.

Well, not really: what happened is that suddenly he got an "unexpected interrupt" and on reset he was unable to find his floppy disks. When I try to access a floppy, the head loads, the light comes on, the disk spins—and nothing at all happens, until eventually the system times out. Clearly there's a bad chip on the controller board. It's also clear that I can probably *replace* that board for less than it will cost me to have someone repair it. Alas, I've been sufficiently harried that I haven't had a chance to do that yet. Real Soon Now. Meanwhile, Big Kat's hard disk works fine. Of course, the only way I can back anything up is to send it out the modem and store it on BIX.

And the Next Problem...

Of course, without floppy disks I wasn't going to test much software this month; but that's all right, because in addition to all those deadlines, due to all those trips I wasn't even *here* for most of the month.

First came COMDEX. It was fun, but there was one problem. I had a deadline that fell in the middle of COMDEX. Not only that, I'd have to send the material to the publisher by modem.

I could have done my writing on the NEC PC-8201. I have a nice 300/1200 modem for it, the TravelComm 1200, and I've been able to use it to connect to BIX and MCI Mail. Unfortunately, it's a little tricky to use—the PC-8201 apparently wants to hear that carrier *very* quickly after it has dialed the number, and sometimes I have problems with that. I could manage, but I wasn't sure I'd be able to get to a phone with a modular connector jack (the one in my hotel didn't have one), and even if I did, I wasn't sure I could manage the tricky protocols the publisher's communications system wanted.

What I'd intended to do was take Zebediah the Zenith Z-181 portable to Las Vegas, do my writing on that, and use Crosstalk to send it in. That's the way I do it here; I'd just take the Crosstalk script with me, and there'd be no problem.

Alas, Zenith is shipping Z-181 portables as fast as they can make them. I got a very early one—and it came with no modem in it. Zenith wasn't able to get me a modem in time. Scratch that idea.

On the other hand, the pressroom was full of Zenith computers, Z-141s I believe, and most of them had modems. By now I was sort of determined to work with a full-screen editor anyway. The PC-8201 is very nice, and with Traveling Software's Ultimate ROM II it can show me 60-character lines; but while eight lines of 60 characters is fine for notes and first drafts, it's a bit small for serious work.

A Matter of Protocol

I confess I had another motive for writing in the pressroom. I wanted to see if I could

continued

NEW

State of the Smart

MiniTEAM
- 0-300, 1200bps full duplex (Bell 103/212A & CCITT V.21/V.22)
- Auto dial (tone or pulse) with call progress detection (ring, busy, dial tone), auto answer
- Local digital loop back test, Analog loop -back test, remote digital loop-back test, long space disconnect detection
- Auto speed selection (0-300, 1200bps)
- Speaker software control

SmarTEAM 1200 AT
- Bell 103, 212A standard
- Auto dial (pulse or tone), auto answer
- 2 self test modes (analog loop back and remote digital loop back test)
- Call progress detection (dial tone, busy)

SmarTEAM 2400B
- Internal slot modem for IBM PC, XT, AT and compatible computers
- 7.5 inches length with the same great features of SmarTEAM 2400

* FCC APPROVED

* Fully Hayes Commands Compatible.



SmarTEAM V.21/23
- 300bps full duplex, 1200bps half duplex, split speed at 75/1200 or 1200/75 switchable. (Bell 103, Bell 202, CCITT V.21 & V.23)
- Auto dial (tone or pulse) with call progress detection (ring, busy, dial tone), auto answer
- Local digital loop back test, analog loop back test.

SmarTEAM 2400
- 0-300, 1200, 2400 bps. Bell 103, 212A CCITT V22, V22 bis. Full duplex
- Auto dial (pulse or tone), auto answer automatically switches between tone and pulse
- 6 self test modes
- Call progress detection (ringing, dial tone, busy)

SmarTEAM 1200 BH
- 5¼" length with the same great features of SmarTEAM 1200 AT, Plus V.21/V.22
- Internal slot modem for IBM PC, XT, AT and compatible.

TEAM™

Quality Communication Products

HEAD OFFICE:

TEAM TECHNOLOGY INC.

10F, No.270, Nan King E. Rd.,
Sec. 3, Taipei, Taiwan, R.O.C.
TLX:19725 TEAMTECH
FAX:(02)7712985
TEL:(02)741-4270

U.S. Sales And Service

SmarTEAM INC.
19205 PARTHENIA St. Ste. J
Northridge, CA 91324
TEL:(818)886-9726
(818)886-9729 (Service No.)
FAX:(818)886-6731

SINGAPORE:

PET Computers
TEL:5331313

U.S. Sales Agent

PDM INTERNATIONAL
Tel:(713)488-8830

MicroAge® computer stores
4326 N.E. 20Th St.
Bellevue, WA 98007
TEL:(206)746-3100

CANADA

BUDGETRON INC.
TEL:(416)673-7800

HOLLAND

COMPUDATA
TEL:(73)422045

NORWAY

PROFESSIONAL SYSTEM A.S
TEL:(02)649220

HONG KONG

QUANTUM DATA SYSTEM LTD.
TEL:3-897278

* Hayes is a registered trademark of hayes Microcomputer Products Inc.
* IBM PC, XT, AT are registered trademark of International Business Machines Corp.
* MITE is a registered trademark of MYCOROFT LABS INC.

Inquiry 300

LOWEST PRICES
NO SURCHARGE ON BANK CARDS
SILICON SPECIALTIES

ORDER LINE 800-354-7330

ZENITH COMPUTERS Always the lowest prices. Call us for a quote.

HARDWARE

PRINTERS
- Alps 2000 $715
- 2100 $1145
- Brother All Models Save
- Citizen MSP-10 $260
- MSP-15 $379
- MSP-20 $319
- MSP-25 $475
- Premier 35 $475
- Diablo D-25 $469
- 635 $765

EPSON
All Printer Models Save

- IBM Proprinter $399
- NEC 3510, 3550 $729
- NEC 8810, 8850 $1045
- P5 $959
- P6 $429
- P7 $609

OKIDATA
All Printer Models Save

- Panasonic 1080 I $195
- 1091 I $259
- 1092 I $319
- 1592 $409
- 3131 $245
- 3151 $385

STAR MICRONICS
All Printer Models Save

KEYBOARDS
- Keytronics 5151 $159

- Toshiba 321 Parallel & Serial $455
- 341E Parallel $669
- 351 Model II $1045
- Laser Printer Save

DISKETTES
- Maxell MD2S (Qty 100) $85
- Sony MD/2 (Qty 100) $85

MONITORS
- Amdex All Monitors Save
- NEC Multisync $575
- Multisync Graphic Board Save
- Princeton Graphics Save
- Zenith All Models Save

VIDEO TERMINALS
- Qume QVT Green 101 $299
- QVT Amber 101 $314
- Wyse 30 $295
- 50 $369
- 75 $559
- Wyse 85 $439
- Wyse 350 $859
- Zenith All Monitors Save

DISK DRIVES
- Iomega Bernoulli 10 meg $1195
- Bernoulli 20 meg $1595
- Bernoulli 40 meg $2325

SEAGATE
20 meg w/Western I/O $385

MODEMS
Anchor Automation
- Signalman Express $185

Practical Peripherals
- Practical 1200 Baud $124

HAYES
All Modems Save

- Prometheus All Models Save
- US Robotics Courier 2400 $349
- Password 1200 $165
- Microlink 2400 $349

BOARDS
- AST All Models Save
- Hercules Color Card $149
- Graphic Card $179
- Intel Above Board PS/PC (1110) $239
- Above Board AT (2010) $329
- Above Board PS/AT (2110) $369
- Above Board PC $210
- NEC Multisync Graphic Board Save
- Orchid Tiny Turbo 286 $415
- Turbo EGA $565
- Paradise Five Pak $99
- EGA Autoswitch $359

Plus Development
- Plus Hard Card 20 Megabyte $609
- Quadram Quad EGA + $359
- Tec Mar Graphics Master $409
- Captain No Memory $109
- EGA Master $239
- Video-7 Vega Enhanced Graphics Adapt $279
- VegaDeluxe $335

COMPUTERS
IBM
- PC 1 Drive 256K $1199
- XT 1 Drive 256K $1729
- XT 1 Drive 2 Meg 640K $2169
- AT/68 $2849
- AT/339 $4449

COMPAQ™
- Portable II—2 Drive $1649

PANASONIC
- Business Partner 819
- Sr. Partner $979
- Exec. Partner $1309
- Other models Save

TOSHIBA
- T-1100 $1299
- T-1100 Plus $1619
- T-3100 $3049

Zenith Computer Products SAVE Up to 50%
All Models Save

PLOTTERS
- Epson Hi-80 Save

SOFTWARE

IBM PC AND 100% Compatibles

TRAINING
- Flight Simulator $28
- PC Logo $69
- Typing Instructor $27
- Typing Tutor III $27
- MS Learning DOS $28

LANGUAGES
- C Compiler (Microsoft) $249
- Fortran Compiler (Microsoft) $195
- Lattice C Compiler $236
- Macro Assembler (Microsoft) $84
- Pascal Compiler (Microsoft) $166
- Quick Basic 2 $55
- Turbo Pascal w/8087 & BCD $55
- Turbo Database Tool Box $38
- Turbo Prolog $54

PROJECT MANAGEMENT
- Harvard Total Project Manager $235
- Microsoft Project $219
- Super Project Plus $269
- Timeline 2.0 Save

COMMUNICATIONS
- CompuServe Starter Kit $19
- Crosstalk XVI $88
- MS Access $139
- Mirror $38
- Remote $88
- Smartcom II $82

INTEGRATIVE SOFTWARE
- Enable 1.1 Save
- Framework II Save
- Smart Software System $399
- Symphony Save
- Ability $55

GRAPHICS
- Chartmaster Save
- Diagram Master Save
- Energraphics 2.0 $269
- In-A-Vision $259
- Microsoft Buss Mouse 6.0 $106
- Microsoft Chart $164
- Microsoft Serial Mouse 6.0 $119
- Newsroom $31
- PC Buss Plus Mouse w/Paint Plus $115
- Click Art Personal Publisher $99
- IMSI Mouse w/Dr. Halo II $99
- PC Paint w/Mouse $115
- Printmaster $29
- Signmaster Save
- Turbo Graphix Tool Box $38

MONEY MANAGEMENT
- Dollars & Sense w/Forcast $92
- Tobias Managing Your Money $105

DATA BASE MANAGEMENT
- Clipper $329
- Cornerstone $55
- dBase II Save
- dBase III Plus Save
- Extended Report Writer Save
- Knowledgeman II PromoPack $295
- PFS: Professional File $119
- Quickcode Plus $138
- QuickReport $138
- Reflex $82
- Think Tank $91

R:Base 5000 System V $355

SPREADSHEETS
- Lotus 1-2-3 Save
- Multiplan $108
- Spreadsheet Auditor 3.0 $82
- VP Planner $47

Supercalc 4 $269

UTILITIES
- MS Windows $55
- Copy II PC $19
- 1 DIR $46
- Fastback $84
- Norton Utilities 3.1 $48
- Printworks $36
- Sidekick (Unprotected) $47
- Travelling Sidekick $39
- Sideways 3.1 $34
- Superkey $39
- Xtree $27
- SQZ $58

WORD PROCESSORS
- Leading Edge Word Processor $19
- Leading Edge W/P w/Spell & Mail $32
- Lightening $55
- Microsoft Word 3.1 $249
- Multimate Advantage $299
- Wordstar w/Tutor $162
- Wordstar Pro Pack $233
- PFS: Professional Write $95

Word Perfect (Ver.4.2) $199
Wordstar 2000 + 2.0 $278

Many other titles available.



MIT SYSTEMS
Turbo PC/XT $425

256 Memory, One 360K Brand Name • Floppy Drive
135 Watt Power Supply, Slide Case, AT Style Keyboard
8 MHz Clock Speed, (Keyboard Selectable), 8 Expansion Slots

SPECIAL
Over $200 worth of Paperback Software Programs
$39 with each system

- Turbo PC/XT w/640K & 1 Drive $465
- Turbo PC/XT w/640K & 2 Drives $545
- Turbo PC/XT w/640K, 1 Drive & 20MG $875
- MonGraphics Card with Parallel Printer Port $ 69
- Color Card with Parallel Print Port $ 65
- Multifunction Card w/Software $ 79
- Amber Monitor (TTL) $ 89
- Amber Monitor w/Swivel Tilt $ 99
- Color Monitor (RGB) $279
- Sega Enhanced Graphics Card $199
- I/O Card (Serial/Parallel) $ 38
- I/O Card (Serial/Clock Calendar) $ 39
- 5151 Clone Keyboard $ 65

MasterCard VISA AMERICAN EXPRESS

SILICON SPECIALTIES
2034 WEST SOUTHERN
MESA, ARIZONA 85202
602-461-0020

CWSS-187

Product shipped in factory cartons with manufacturer's warranty. Please add $10.00 per order for UPS shipping. Prices & availability subject to change without notice. Send cashier's check or money order...all other checks will delay shipping two weeks.

Inquiry 275 for MS DOS Products. Inquiry 276 for all others.

Inquiry 351 for DEALERS ONLY.

PROM/PAL PROGRAMMING?

From $250.00

Finding a Low-Cost PROM or PAL* programmer is only half of the battle. Finding a company that won't desert you when you need support or service is the other half.

Logical Devices Products **cost** you **less** because we offer the best price performance ratio in the market, **and** because once you buy our products you will experience less down time and **more reliable** operation than most other units. In addition you get features that were evolved from our years of experience of serving people who program chips.

We offer a wide range of products from dedicated programmers to universal software driven models.



GANGPRO-8 production programmer. 8 EPROMs to 27512 with RS-232 option.

PROMPRO-8X universal portable. RS-232. Programs PROMs/PAL*s/Micros

PALPRO-2X Low Cost PAL* only pro grammer. Dedicated, RS-232 unit.

SHOOTER Low cost EPROM only programmer. RS-232, Stand-Alone.

PC-PRO IBM PC plug-in EPROM card 2716-27512

ALLPRO pin driven software based universal unit, programs every imaginable fuse programmable IC.

CAST boolean software/silicon compiler for PLDs. JEDEC output

UV ERASERS FROM $49.95

All products carry 90 day Warranty *& 14 day Money Back Guarantee*

CALL 1-800-331-7766
LOGICAL DEVICES INC.

See us at
ELECTRO '87
Booth 326

*PAL IS A REGISTERED TRADEMARK OF MONOLITHIC MEMORIES INC.

I've heard that WordStar 4.0 will be NewWord with some additional features.

do it. My friend Harlan Ellison often writes short stories in bookstore windows and other public places; some say he needs the additional motivation, but I think that's a cruel canard. Anyway, he does that.

I don't work that way. Generally when I'm writing, I jump halfway to the ceiling when someone comes into the room; there aren't many people I let stand within 30 feet of me while I work. However, years ago—back in the Dark Ages when I had to use a typewriter—I was sometimes able to write short pieces from the pressroom at meetings of the American Association for the Advancement of Science. Anyway, it seemed an amusing experiment.

It worked, too. There were drawbacks. The main one was WordStar. For reasons I don't recall, the only editor that would work on the machine I had to use was WordStar. I had forgotten just how much I dislike that program. The last time I used something like WordStar, I was really using NewWord.

Incidentally, I ran into Charlie Stevenson, chief programmer for MicroPro, and asked him if they were going to replace WordStar with NewWord now that MicroPro has bought out NewWord. Charlie said, "I'm not allowed to talk about NewWord." I've heard from other sources, though, that WordStar 4.0 will be NewWord with some additional features.

Moreover, I found after an hour that I don't really *hate* WordStar. It's old-fashioned, lacks features we now expect, and it's too slow; but it does get the job done. Beats heck out of a typewriter, the help screens are there when you need them (and can be suppressed when you don't want them), and despite the frustrations I can turn out text with the program.

Oddly enough that happened to me once before: about 1980 when I was part of a NASA study group out in the middle of nowhere, and when it came time to write I had a choice of WordStar on a Zenith, a Selectric typewriter, or a ballpoint pen. I chose WordStar happily enough and got more written than the next two people in the study.

All of which confirms one of Pournelle's rules: WordStar is almost no one's favorite program, but it's nearly everyone's second choice. You have to know it for self-defense, because if you're in a strange situation, chances are the text editor you'll be offered will be WordStar.

Modern Communications

Anyway, I got my writing done. Next problem was to send it to the publisher. *That* turned out to be the real bear for the day.

First, credit where credit is due: I would still be there in that pressroom trying to send my material if not for David E. Coursey, who writes for *Texas Computer Market* and *MISWeek*. There was some kind of communications software on the machines furnished us in the pressroom, but no documents, and I wasn't able to make heads or tails of it. My first attempts to send the material ended in utter failure.

I then found a copy of Crosstalk and tried that; but I clearly did something wrong, because that didn't work either. I've no notion why.

Dave Coursey, bless him, had been watching from the next machine and rather bemusedly offered to help.

He had brought his own communications program, called Relay, which is published by VM Personal Computing. It worked, and it looks easy enough to use.

Looks it, but the fact is that even with Dave's help it took about an hour to send in my material. First we had to set up all the parameters. Then we sent it, and I called to have the publisher look at it. They had garbage.

"Of course," Dave Coursey and I realized at the same time. "We sent a WordStar file." WordStar does nasty things to text, including setting high bits and putting lots of control characters into the text stream. Clearly we needed to change that.

There followed about 10 minutes of trying to figure out how to make WordStar read in a document in WordStar format, then write it back out in nondocument format. That was futile. WordStar, as it happens, can't *do* that.

"Print to disk," someone suggested. "Make it print out to disk. That will strip out all the weird characters."

That sounded like a good idea, and we tried it. I forget whether it wrote garbage or didn't work at all, but in any event we weren't able to make it work.

"At home I have a filter program," I said. "Hmm." We looked at the disk directory. There was a program called CONVERT.COM. In desperation we tried that, and it worked fine, converting my WordStar file to an ASCII file. After that Dave was able to get Relay to send my material in. It had taken only about 15 minutes longer to send it than it did to write it. Oh, well.

I know one thing. In future I'm going to take a full system: computer, text editor,

continued

Breaking the 640K DOS Barrier:

New version of Alsys PC AT Ada* compiler improves speed, adds application developer's guide, brings seven 80286 machines to latest validation status.



Alsys' landmark Ada compiler for the PC AT, the first to bring Ada to popular-priced microcomputers, has been upgraded to Version 1.2 with significant improvements.

The new version compiles faster than its predecessor, is validated for a full range of popular compatibles using the latest AJPO test suite 1.7, and includes a Developer's Guide in the documentation set. The price remains at $2,995 for single units, including a 4 megabyte RAM board.

Both the original and the newly upgraded versions utilize the inherent capabilities of the 80286 chip and "virtual mode" to eliminate the 640K limitations of DOS. These techniques permit addressing up to 16 MB of memory, under the control of DOS, without changes to DOS in any way!

80286 machines validated in the new release include HP's Vectra, Compaq's Deskpro 286, Sperry's PC/IT, Zenith's 200 series (including the Z-248), Tandy's 3000 HD, the Goupil/40, and the IBM PC AT. The compiler supports DOS 3.0 or higher. Ada programs compiled on the AT will also run on PCs and XTs supporting DOS 2.1 or higher.

alsys

ALSYS, INC.,
1432 Main Street, Waltham, MA 02154
BY387

ADA NOW. Tell me more about the PC AT Ada compiler.

Name _____
Title _____
Company _____
Address _____
City _____
State/Zip _____
Phone/Ext _____

In the US: Alsys Inc., 1432 Main St., Waltham, MA 02154 Tel: (617) 890-0030
In the UK: Alsys Ltd., Partridge House, Newtown Rd., Henley-on-Thames, Oxon RG9 1EN Tel: 44 (491) 579090
In the rest of the world: Alsys SA, 29, Avenue de Versailles, 78170 La Celle St. Cloud, France Tel: 33 (1) 3918.12.44

*Ada is a registered trademark of the U.S. Government (AJPO). Alsys is the trademark of Alsys, Inc. References to other computer systems use trademarks owned by the respective manufacturers.

Prices refer to U.S. only. Contact Alsys for prices in other countries.

Inquiry 14

NOW AVAILABLE AdaPROBE™ Program Viewer and Symbolic Debugger for the AT and compatibles.

Ada now

FEATURES STANDARD WITH US, OTHERS DON'T EVEN OFFER AS OPTIONS.



Take our ARC Turbo 12, for example.

Take its speed. The fastest off-the-shelf AT™ compatible you can buy. (12.5 MHz, 50% faster than IBM.™)

Take the ARC Turbo 12's exclusive MIPS Meter,™ which gives you a digital read out of the actual number of millions of instructions per second currently being processed.

And take ARC's unmatched reliability. Which is what you'd expect from one of the fastest growing computer manufacturers.

We back our equipment with a two-year limited warranty, the longest in the industry. Each unit also comes with 90 days of *Free* on-site service. And our technical support Hot Line gives you direct access to our expert staff.

Ask your ARC Authorized Dealer for all the details. (For a list, call 800-654-6151.)

It's a fast world. With ARC, it won't pass you by.



ARC American Research Corporation

Inquiry 362 for End-Users. Inquiry 363 for DEALERS ONLY.

modem, and communications software; and for a backup I'll take my own copies of editing and communications software I've *used* and *tested*.

The Curse Continues

The simplest solution to that problem would be to set up the Z-181. After all, I'm writing *this* column with WordPerfect, and the Z-181 has a highly visible screen with 25 lines of 80 characters; there shouldn't be any problems. Unlike WordStar, WordPerfect has a very simple way to save your files in ASCII format, ready for sending out over any reasonable modem.

I'm sure, too, that's what I'll eventually do; but just now I can't.

Now that COMDEX is over, I have the modem for the Zenith Z-181. It's made by OmniTel. I have been using an OmniTel internal modem in the Kaypro 286i for nearly two years now with no problems; indeed, with few exceptions every column I've filed in the last year has gone out over the OmniTel. Meanwhile, my son Alex has an OmniTel external modem; it had some kind of glitch, but it was under warranty and they fixed it within a couple of days. He runs his bulletin board from it. In other words, we're very happy with OmniTel communications hardware, so that's no problem.

Alas, I got the modem directly from OmniTel, and somehow the hardware, documents, and software got separated. Installing the modem is no problem: you remove three screws from the Z-181, and the little cover plate comes off. The OmniTel modem will only go in one way and slides in fine. It's held in by two small machine screws. Put the Zenith cover plate back on, and all is fine.

Unfortunately, I can't test the modem since I have no software.

At this point someone is sure to remember that the Z-181 is fully PCompatible and ask, "Why not transfer some software from one of the IBM PC machines to the Zenith? Surely there is a way?"

And indeed there is. The Zenith came with two copies of a program called PCXFER, one copy on 3½-inch disks for the Z-181, and one copy on 5¼-inch disks for the PC. All it takes is a "null modem" cable, and I have those.

What I haven't done is put the doggone PCXFER program onto the Kaypro 286i, and, you'll recall, Big Kat is just now without floppy disks. As for other PCompatible systems, Zenith is supposed to have got me the Z-248 AT clone, which I was going to use to supplement—possibly eventually replace—Big Kat, and Tandy has promised a Tandy 3000 ma-

continued

Inquiry 288

BRIEF is "Recommended."

— Jerry Pournelle
Byte Magazine, 12/86

"If you need a general purpose PC programming editor, look no further."
Jerry Pournelle, Byte, 12/86.

- A high-level, readable *Macro Programming Language* - allows customization for programming languages . . . Complete, unlimited variables, etc.
- Edit *multiple* files of *unlimited size* (2 Meg is OK)
- Multiple *Windows* on screen with different or same file, fragments, etc.
- A bona-fide *UNDO* stack (up to 300) of *all operations*; deletions, reading files, search, translate, more.
- Reconfigurable keyboard
- Full "*regular expression search*" - wild cards, complex patterns
- Adjustable line length - up to 512.
- *Keystroke macros* - for common typing sequences
- Suspend BRIEF to execute, *exit to DOS* - run another program (like a compiler, dir, XREF, DIFF, or DEBUG) then resume BRIEF session
- *Compiler-specific* support like auto indent, syntax check, compile within BRIEF

Survey Data
88% of survey respondents were more productive with BRIEF than other editors.
50% were more productive with BRIEF than their previous editor in 5 hours or less.
72% were performing all operations in 2 hours.

Only $195
Call 800-821-2492

Full Refund if not satisfied in 30 days.

Solution Systems
335-B Washington St.
Norwell, MA 02061
617-659-1571

For PC, AT, & compatibles.

UNLOCK™ Removes Copy Protection

Produces Unprotected Backup Copies

RUNS YOUR SOFTWARE ON ANY HARD DISK

UNlock "copying" disk allows you to make "unprotected" DOS copies of popular original program disks. **Unprotected backup copies** perform perfectly, as do copies of these copies. UNlock copies **run on any hard disk,** including Bernoulli Boxes. No original required in drive "A." **Run on a RAM disk** simply and conveniently. **Also, copy DOS 5¼" programs to 3½" diskettes.** For IBM® PC, XT, AT, compatibles, 256K or more, DOS 2.1 or higher. Choice of the critics!

Guaranteed to work only with programs below:

SPECIAL OFFER "Best of UNLOCK" ALBUM "D" PLUS **$74.95** (Plus $4 ship handling. Foreign orders $10)

- dBASE III & dBASE III PLUS™
- FRAMEWORK I & II™
- CLIPPER™
- FASTBACK™ (5.3)
- CHARTMASTER™ (6.1)
- SIGNMASTER™ (5.1)
- DOLLARS & SENSE™ (2.0)
- LOTUS 1-2-3™ (1.A-2.0)
- SYMPHONY™ (1.1)
- LOTUS 1-2-3 REPORT WRITER™ (1.0)
- DOUBLEDOS™
- HARVARD TOTAL PROJECT MGR.™ (1.10)
- MANAGING YOUR MONEY™ (1.5, 1.51, 2.0)
- THINKTANK™ (2.0, 2.1)
- MICROSOFT WORD™ (1.15, 2.0, 2.01)

UNLOCK™ FLIGHT/JET #202 **$29.95**
• FLIGHT SIMULATOR™ • JET™ • SCENERY DISKS (Plus $4 ship handling. Foreign orders $10)

Recommended by the editors of: PERSONAL COMPUTING "The Best Software Utilities For Under $100"

TRANSEC UNLOCK™

ORDER TODAY TOLL FREE:
1-800-423-0772
IN FL: 1-305-276-1500

TranSec Systems, Inc., 220 Congress Park Drive, Delray Beach, FL 33445

Trademarks are the sole property of their respective owners. UNlock is for use only to improve the useability of legally acquired and operated software.

chine for the same purpose; but both of those are coming Real Soon Now. The AT&T PC 6300 Plus sits out there with a single floppy disk drive and a hard disk so full of UNIX stuff there's no room for any PC software. So I'm stuck with Big Kat and no floppies.

I suppose I could use the AT&T machine, or even go downstairs and fire up Lucy Van Pelt, our absolutely genuine very early issue fussbudget IBM PC, and use PCXFER on one of those; but frankly I'm disgusted. Besides, tomorrow I'm supposed to go hole up where no one can find me to finish the third volume of the *Janissaries* series (this one will be entitled *Storms of Victory*), and if I take a working modem system with me, I'll be tempted to log on to BIX, which will defeat a good part of the reason for hiding.

I make no doubt all will resolve itself. Meanwhile, I keep feeling as if I were sailing under a curse.

WordPerfect Isn't

If that weren't enough problems, I discover that WordPerfect is designed to drive me nuts after all. The search-and-replace function doesn't quite work.

When you italicize a word in WordPerfect, you push the F8 function key. The word changes color on a color screen and presumably does something else on a monochrome monitor. When you're done with what you want to italicize, you push F8 again. So far, so good. Since WordPerfect is a "what you see is what you get" editor, you do not see any control codes or anything inserted in the text. However, WordPerfect (WP in future) has a "reveal codes" command that will let you see what it has done, and it shows that it has apparently inserted the text string [U] just before the italicized words and [u] after them. Great. But if you search for [U] with the search command, it says there are none.

This is a problem because if you save your WP file as ASCII text—and you have to if you want to send it over a modem—then it strips out all those codes, which means that all my carefully inserted italicized words come out just like any others. I had wanted to replace the [U] business with the underbar character (which is what WRITE does). The people at BYTE have always been able to interpret that properly.

But if WP can't *find* its own control characters, then what in the world am I to do? I'll have to go through and change every one of those by hand; not something I'm particularly fond of doing. Time to putter around . . .

Later. Indeed, it's worse than I thought. If you punch the F8 key when you go to do a search and replace, it will indeed find the italics marker—but it replaces *only* the *leading* [U] nonsense with the underbar and throws the trailing [u] away. And apparently there is no way to do anything about that, meaning that I will indeed have to replace all the control characters by hand. Wonderful.

For all that, WP is still the editor I'm using and will probably keep on using; but I confess it would be nice to find one that was a little more straightforward.

Flash: you can do it with macros. More next month, but I do like WordPerfect.

COMDEX and the 386

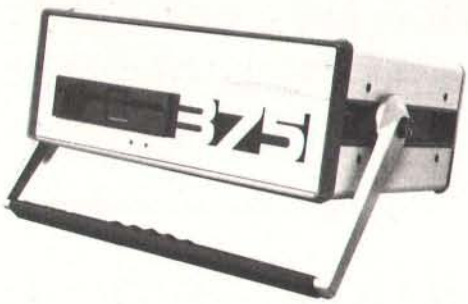
COMDEX was interesting. I liked the mood: the computer industry seems to have got out of the doldrums. On the other hand, there wasn't much very new there. Most were announcements of things that will be out Real Soon Now.

There were a mess of 80386 machines, but again most were prototypes. Until IBM tells the world what the 386 operating system is going to be, 386 machines aren't a lot more than fast single-user PCs anyway.

continued

SYMMETRIC
COMPUTER SYSTEMS

THE 375 - A SOFTWARE DEVELOPER'S DREAM



THE BEAUTY AND THE BSD

$4,995*

OVER 1,000 PROGRAMS, 3,000 FILES !

Full 4.2BSD UNIX™
Each 375 comes standard with a complete configurable 4.2BSD UNIX system. We don't skimp on software. And we can even give you EMACS, INGRES, TEX and SPICE for those special applications.

Loaded With Languages
Turn on your 375 and start developing your own applications. It's that easy. C, FORTRAN, PASCAL, BASIC, APL, Assembler, LISP and PROLOG: they all come standard on every 375.

Loaded With Standard Features

- ★ 50MB Winchester Disc Drive
- ★ 1MB 5¼" Floppy
- ★ 2MB RAM (8MB optional)
- ★ Integral SCSI & ST506 Interfaces
- ★ 4 RS232 Ports (up to 36 optional!)
- ★ Parallel Printer Port
- ★ External Winchester and Floppy Ports
- ★ Series 32000, 10MHz, VM, FPU

Also Available: 10 Mb ETHERNET, up to 280MB disk memory, streaming tape, and more !

A Portable Computer for the Serious User

At last, a powerful, portable (22lbs) scientific computer for all your serious work. The 375 combines the advantages of a VAX™ with the size, versatility, and price of a micro. All the software tools are there. It's even small enough to leave on your desktop or take wherever you need it. **And it's available direct to you right now !**

CALL US TODAY (408) 279-0700

SYMMETRIC COMPUTER SYSTEMS — 5698 Stewart Ave. — Fremont, CA 94538

* Prepaid. Sales tax and Shipping Costs not included.
UNIX is a registered trademark of AT&T Bell Labs.
VAX is a trademark of Digital Equipment Series 32000 is a trademark of National Semiconductor Corp.

Inquiry 296

THE PROGRAMMER'S SHOP

helps save time, money and cut frustrations. Compare, evaluate, and find products.

RECENT DISCOVERY

The Documentor - for dBASE, program flow charts, tree diagrams, .DBF documentation, variable/field concordance, hierarchy charts. Macros, searches, configure options. MS $ 295

AI-Expert System Dev't

Arity System-incorporate w/C.	MS	$ 259
Auto-Intelligence - by IntelligenceWare	PC	$ 749
Experteach-Improved, samples	PC	$ 349
EXSYS	PC	$ 339
Insight 2+	MS	$ 389
Intelligence/Compiler - rules, frames	PC	$ 749
Texas Instruments: PC Easy	PC	$ 439
Personal Consultant Plus	PC	$2599

AI-Lisp

Microsoft MuLisp 85	MS	$ 179
PC Scheme LISP - by TI. SCHEME has simple, "orthogonal" syntax.	PC	$ 85
TLC LISP - classes, **compiler.**	MS	$ 225
TransLISP - Good for learning	MS	Call

Others: IQ LISP ($155), UNX LISP ($59), IQC LISP ($269), WALTZ LISP ($139)

AI-Prolog

APT - Active Prolog Tutor - build applications interactively	PC	$ 65
ARITY Standard - full, 4 Meg Interpreter - debug, C, ASM	PC	$ 319
COMPILER/Interpreter-EXE	PC	$ 699
With Exp Sys, Screen - KIT	PC	$1129
LPA MacProlog - Complete incremental compiler and an interpreter	MAC	$ 295
LPA MicroProlog - intro	MS	$ 85
LPA MicroProlog Prof. - full memory	MS	$ 339
MPROLOG	PC	$ 475
Prolog-86 - Learn Fast	MS	$ 89
Prolog-86 Plus - Develop	MS	$ 229
TURBO PROLOG by Borland	PC	$ 69

Editors for Programming

BRIEF Programmer's Editor - undo, windows, reconfigure	PC	Call
EMACS by UniPress - powerful, multifile, MLISP. Source: $929		$ 299
Epsilon - like EMACS	PC	$ 155
Kedit - like XEDIT	PC	$ 105
Lattice Screen Editor-multiwindow multi-tasking Amiga $ 89	MS	$ 109
PC/VI - Custom Software	MS	$ 109
Personal REXX	PC	$ 109
PMATE - power, multitask	PC	$ 109
SPF/PC - fast, virtual memory	PC	$ 139
XTC - multitasking	PC	$ 79

FEATURES

Poly Boost - Run 2 to 10 times faster with software accelerator. Speeds disk access, screen display, keyboard input. PC $ 69

C Scape - capture Dan Bricklin's, 1-2-3, Turbo screens & more, convert to C. Plus full screen generation package - tiled, pop-up windows with scrolling, validation. Source PC $149

National Accounts

MIS, Engineering, and Research departments get special FREE consulting, product comparisons, reports, newsletters. Compare approaches to COBOL, C, AI. PURCHASING AGENTS - get help and special service finding products, negotiating license agreements, with billing and more. Call 800-446-1185.

Our Services:

- Programmer's Referral List
- Compare Products
- Help find a Publisher
- Evaluation Literature FREE
- BBS - 7 PM to 7 AM 617-826-4086
- Dealers Inquire
- Newsletter
- Rush Order
- Over 700 products
- *National Accounts Center*

C Support-Systems

Basic-C Library by C Source	MS	$139
C Sharp - **realtime,** tasks	PC	$600
C ToolSet - DIFF, xref, source	MS	$ 95
The HAMMER by OES Systems	PC	$149
Lattice Text Utilities	PC	$ 89
Multi-C - multitasking	PC	$149
PC LINT-checker. Amiga $89,	MS	$107
SECURITY LIB - add encrypt to MSC. C86 programs. Source $229	PC	$115
Quickshell - script compiler	PC	$349

Fortran & Supporting

50: More FORTRAN - math, source	PC	$ 99
Forlib+ by Alpha - graph, comm.		$ 59
MACFortran by Microsoft - full '77		$229
MS Fortran - 4.0, full '77		$269
No Limit - Fortran Scientific		$119
RM/Fortran - enhanced "IBM Ftn"		$389
Scientific Subroutines - Matrix		$149

MultiLanguage Support

BTRIEVE ISAM	MS	$199
BTRIEVE/N - multiuser	MS	$469
CODESIFTER - Execution PROFILER. Spot bottlenecks.	MS	$ 99
Dan Bricklin's Demo Program	PC	$ 65
HALO Graphics - 115+ device interfaces, rich, printer. Specify language interface	PC	$209
Microsoft Windows Software Development Kit	PC	$349
PANEL Xenix $539,	MS	$219
Pfinish Performance Analyzer	MS	$249
PLINK-86 - a program-independent overlay linker to 32 levels.	MS	$249
PLINK-86 PLUS - incremental	MS	$369
PolyLibrarian	MS	$ 79
PVCS Version Control	MS	$329
Screen Sculptor - slick, thorough	PC	$ 95
ZAP Communications - VT 100, TEK 4010 emulation, file xfer.	PC	$ 89

Atari ST & Amiga

We carry full lines of Manx, Lattice, & Metacomco.

Call for a catalog, literature and *solid* value

800-421-8006

THE PROGRAMMER'S SHOP™
5-B Pond Park Road, Hingham, MA 02043
Mass: 800-442-8070 or 617-826-7531 1/87

RECENT DISCOVERY

r-tree - report generation for ctree. Multiple file handling, fixed or variable length. Many built-in functions, like Boolean, computational functions, string, date handling, numeric to string conversion. Layout control. Source in C. PC $ 249

C Language-Compilers

AZTEC C86 - Commercial	PC	$ 499
C86 by CI - 8087, reliable	MS	$ 299
C86 Plus by CI	MS	$ 459
Datalight C - fast compile, good code, 4 models, Lattice compatible, Lib source. Dev'rs Kit	PC	$ 77
HOT C - new, intriguing	PC	$ 85
Lattice C - from Lattice	MS	$ 289
Mark Williams - w/debugger	MS	$ 369
Microsoft C 4.0 - CodeView	MS	$ **279**
Wizard C - full, fast.	MS	$ 359

C Language-Interpreters

C-terp by Gimpel - full K & R	MS	$ 229
C Trainer by Catalytix	PC	$ 89
INSTANT C - Source debug, Edit to Run-3 seconds, .OBJs	MS	$ 379
Interactive C - interpreter, editor	PC	$ 225
Introducing C - learn C quickly	PC	$ 105
Run/C Professional -	MS	$ 179
Run/C Lite - improved	MS	$ 97

C Libraries-General

Blackstar C Function Library	PC	$ 79
C Essentials by Essential	PC	$ 83
C Food by Lattice-ask for source	MS	$ 99
C Scientific Subroutines-Peerless	MS	$ 135
C Tools Plus (1&2)	PC	$ 135
C Utilities by Essential - Comprehensive screen graphics, strings. Source.	PC	$ 137
C Worthy Library	MS	$ 269
Entelekon C Function Library	PC	$ 119
Greenleaf Functions-portable, ASM		$ 139
PforCe by Phoenix - objects	PC	$ 229

C-Screens. Windows. Graphics

C Power Windows by Entelekon	PC	$ 109
dBASE Graphics for C	PC	$ 69
Curses by Lattice	PC	$ 89
ESSENTIAL GRAPHICS - fast	PC	$ 199
GraphiC - mono version	PC	$ 217
GraphiC - new color version	PC	$ 295
Greenleaf Data Window	PC	$ 189
w/source	PC	$ 339
Multi-Windows-use w/Multi-C	PC	$ 295
Screen Ace Form Master	PC	$ 195
Vitamin C - screen I/O	PC	$ 159
Windows for C - fast	PC	$ 159
Windows for Data - validation	PC	$ 239
ZView - screen generator	MS	$ 189

FEATURE

Uniware Cross Development Tools - include 68000 C compiler. Development Package with compiler, assembler, link editor, and utilities, 17 cross assemblers for Intel, TI, Motorola, Zilog, etc. - relocatable, macros. MS Call

Note: All prices subject to change without notice. Mention this ad. Some prices are specials. Ask about COD and POs. Formats: 3" laptop now available, plus 200 others. UPS surface shipping add $3/item.

Inquiry 238

The most interesting 386s were the new Zenith and a new machine from PC's Limited. Both these machines have something in common, a resident monitor in ROM.

Now all computers have a subprogram called a monitor. What that does is look at all the input and output and decide what to do with it. For most machines this program is totally invisible. However, back in the early days of small computers, it was common to have an accessible monitor that could take control of the machine and allow you to conduct various system tests, look at and change memory locations, send data out ports, and generally do by hand anything a program can do. The original Zeke I, my friend who happened to be a Z80, had a program called XMON that was the envy of all my other friends, because whenever my system crashed—and in those days systems crashed a *lot*—I could get in there and fix things, or at least see what was going on.

As micros got more reliable, and aimed more at the general public than at people willing to spend time understanding their equipment, the monitor program got buried deeper and deeper into the operating system, and in most machines it vanished from the user's view. Zenith, however, has always retained the monitor program, and while it's usually invisible, you can still get access to it if you think you need to. I've described in a previous column how I managed to fix a temporary glitch in the Z-181 by using the monitor program to boot the machine off the B drive.

Small machines also used to have what was called a "front panel," which was a hardware look into what the machine was doing. In the movies all computers have front panels, because front panels have, among other things, flashing lights.

PC's Limited has brought back not only the user-accessible monitor, but also flashing lights: they have a small LED display that tells things about the status of the machine, and which can be used as an aid to diagnostics.

Their machines are also *fast*. I was much impressed with PC's Limited at the Atlanta COMDEX; I was more so this time. As it happens I met the company's president at the "real" Pournelle/Dvorak party (which was hidden so well I almost didn't find it; and still more than 150 people showed up!). They've arranged for me to get one of their systems. I don't write much about stuff that's not running here in Chaos Manor, but I confess some anticipation.

In addition to their computers, they have a complete line of PC add-on products. Again, I've not tested any of their stuff; but I was highly impressed with what I saw at COMDEX, and I keep hearing good things about the company.

Virtual?

One of the most interesting interviews I managed at COMDEX was with Ken Williams, vice president of R&D for Softguard.

Softguard is a weird company. They make most of their revenue from copy-protection software. Since I hate copy protection, and they know it, I wondered if I were walking into the lion's den when I went up to their suite in the Bally Grand Hotel; but when I got there I found that all their programmers, including Williams, hate copy protection about as much as I do. "It's going to be done," Williams said, "and our schemes are more harmless than most, and it makes us enough money that we can work on things we like to work on."

What they like working on is VM386, which is a virtual operating system for the 386 chip.

When I first heard about VM386, I didn't quite understand. That, as it turns

continued

Lattice® Works

LATTICE ANNOUNCES MICROSOFT WINDOWS SUPPORT IN VERSION 3.2

Version 3.2 of the Lattice MS-DOS C Compiler features full support for Microsoft Windows—including the "far," "near," and "pascal" keywords.

In addition, version 3.2 includes the ability to generate more than 64K bytes of static data and to declare objects larger than 64K bytes. It also includes improved support for ROM-based applications via the "const" data type. Version 3.2 is a significant release because it eliminates Microsoft's claimed monopoly on future MS-DOS C development tools. Now that the Lattice MS-DOS C Compiler supports a window interface, programmers using Lattice C can avoid the problems caused by switching to a different compiler. $500.00

LATTICE NOW OFFERS ENHANCED AmigaDOS C COMPILER

Version 3.1 of the Lattice AmigaDOS C Compiler offers a new library with 100 more functions than the standard AmigaDOS C Compiler. What's more, increased library modularity and new addressing modes help reduce load module sizes by more than 20%. The new version also features faster pointer and integer math, faster IEEE floating point routines, direct support of the Amiga's FFP format floating point library, and multi-tasking support.

With Version 3.1, Lattice has broken free of the reliance on the Amiga standard linker and object file format. This new release includes completely new expanded documentation, and a Lattice assembler and linker which remain compatible with previous software but allows professional programmers to take advantage of both the Amiga's speed and the industry's standardization.

Lattice AmigaDOS C Compiler with Lattice's Text Management Utilities, $225. Professional AmigaDOS C Compiler with, Text Management Utilities, Lattice Make Utility, Lattice Screen Editor, and the Metadigm MetaScope Debugger, $375. AmigaDOS C Compiler $150.

LATTICE RELEASES NEW VERSIONS OF C CROSS COMPILER AND LINKER

Version 3.1 of the Lattice C Cross Compiler to MS-DOS and version 2.12 of the Plink86Plus Overlay Linker are now available for Sun and Apollo workstations as well as the DEC VAX Family of processors running VMS, UNIX or Berkeley UNIX.

All Lattice C Cross Compilers possess the same functionality and generate the same code as the native Lattice MS-DOS C Compiler. This allows users to take advantage of the larger systems' speed and multi-user capabilities when creating applications for most popular PCs.

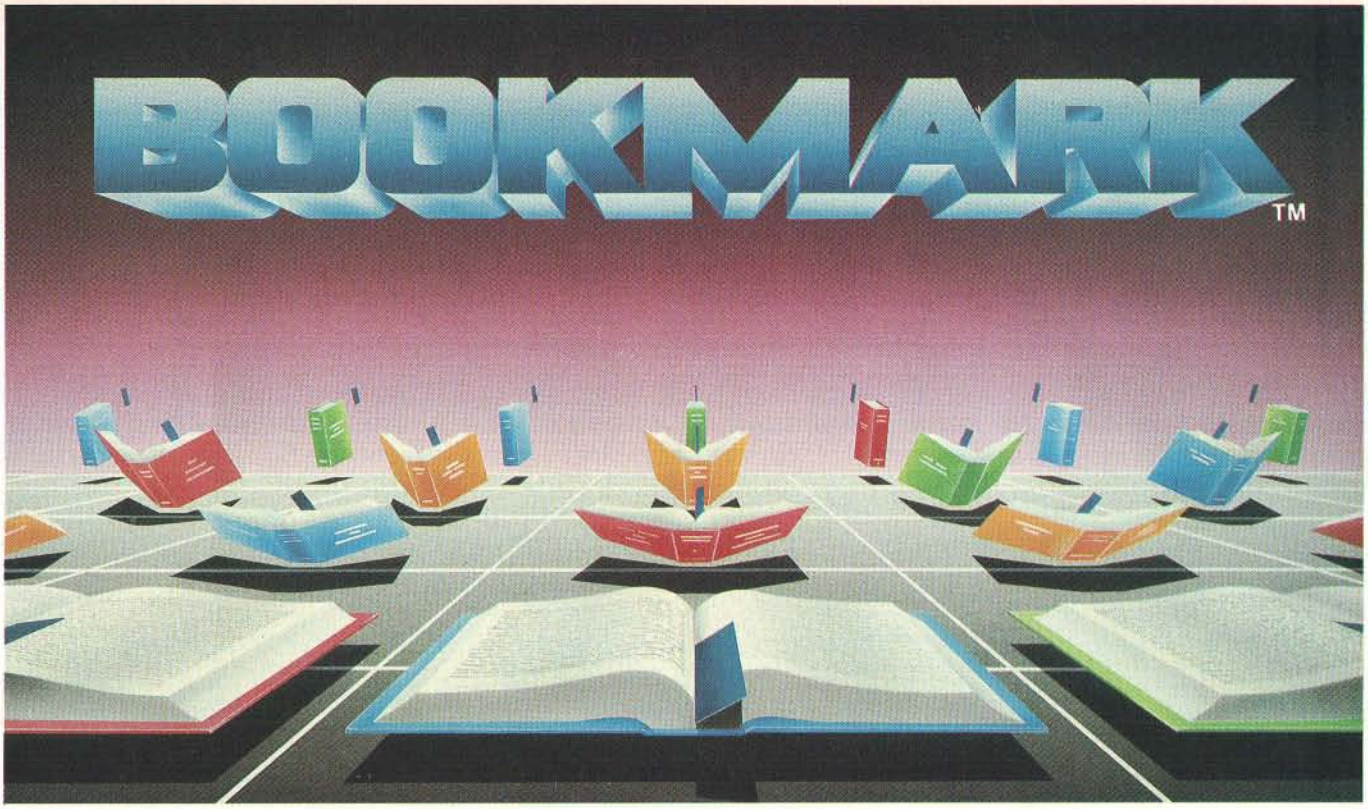
Contact Lattice Corporate Sales for details.

Lattice

(800)533-3577 In Illinois (312) 858-7950 TELEX 532253 FAX (312) 858-8473

INTERNATIONAL SALES OFFICES: Benelux: Ines Datacom (32)2-720-51-61
Japan: Lifeboat, Inc. (03)293-4711 England: Roundhill (0672)54675
France: Echosoft (1)4824.54.04 Germany: Pfotenhaur (49)7841/5058
Hong Kong: Prima 85258442525 A.I. Soft Korea, Inc. (02)7836372
Australia: FMS (03) 699-9899 Italy: Lifeboat Associates Italia (02) 46.46.01

Inquiry 162



BOOKMARK™ Data Protection Software

Automatically marks your place so you can resume where you left off.

Runs with most software so if you decide to call it a day you can power down, and upon restart BOOKMARK will bring you back where you left off...it's like having a BOOKMARK in your computer!

Stop wasting time navigating through menus . . . or teaching novices.

Easy to use. You choose how often work is saved, by number of keystrokes or length of time.

Work in progress can be resumed within seconds after system crash, power failure, accidental reset or power down.

Costly battery backup systems are no longer needed when work in progress is already saved to the point of the previous BOOKMARK placement.

BOOKMARK is a memory-resident utility that automatically and periodically saves work in progress to a reserved area of the hard disk.

Suggested Retail Price **$69.95**

Requirements:
IBM PC/XT/AT or 100% Compatible
64k to 640k
IBM DOS 2.1 or Higher
1 Floppy Disk Drive • Hard Disk Drive (10 Megbytes Minimum) • Video Display Adapter, IBM (Monochrome, Color, Enhanced Color), Hercules, AST
(BOOKMARK occupies an equivalent space on hard disk as in system RAM plus video RAM)

To Order, Call INTELLISOFT International or Ask Your Dealer for BOOKMARK

INTELLISOFT™

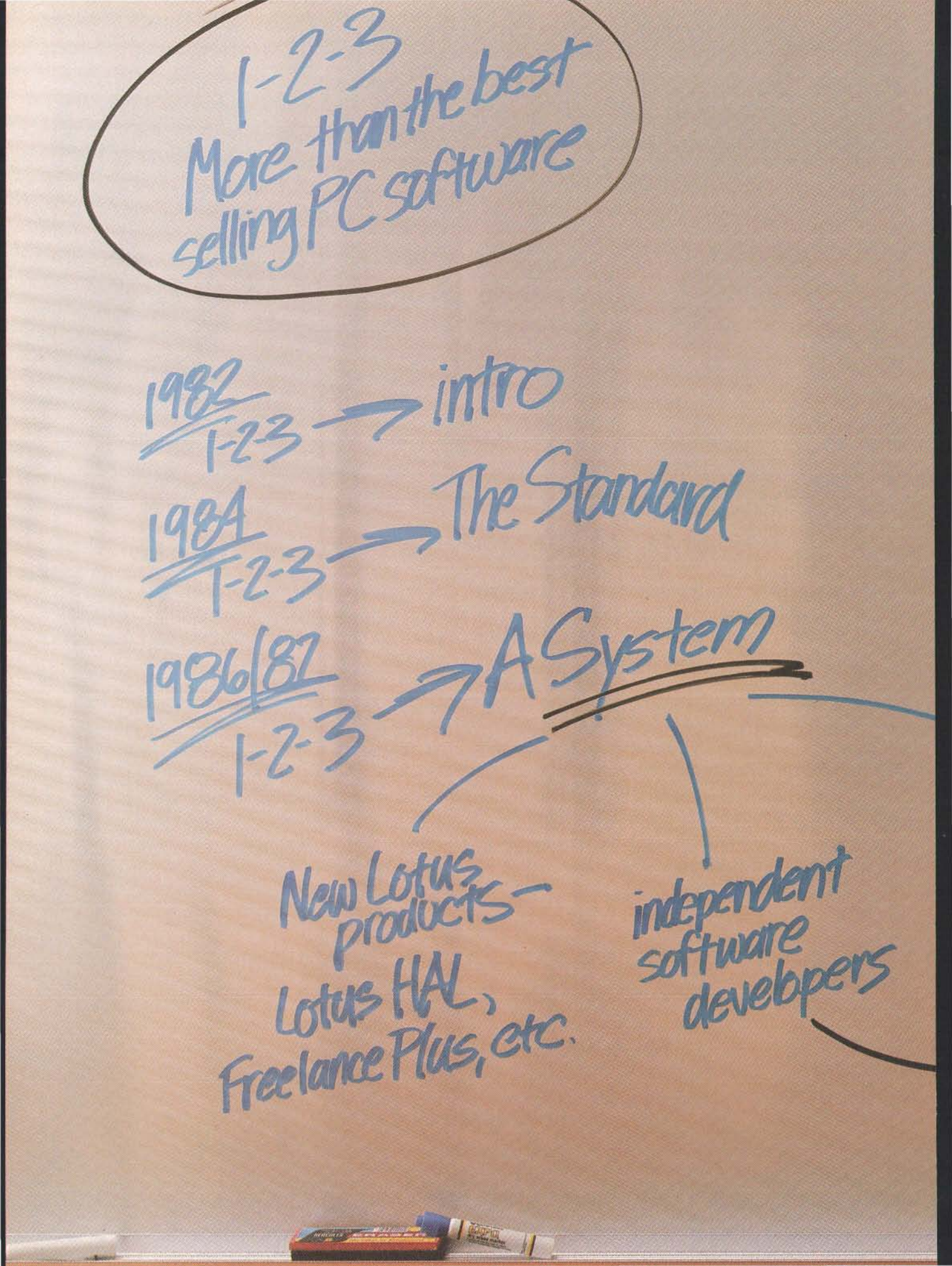
INTERNATIONAL

See Us At
HANNOVER MESSE CeBIT'87
World Center · Office · Information · Telecommunications
USA Pavillion, Stand P5

Call Toll Free (800) 544-MARK · In California Call Toll Free (800) 543-MARK
70 Digital Drive · P.O. Box 1972 · Novato, California 94948 · (415) 883-1188

BOOKMARK™ is a trademark of INTELLISOFT International. Copyright © 1986 by INTELLISOFT International. All rights reserved.
IBM PC/XT/AT are registered trademarks of International Business Machines Corporation. Hercules is a trademark of Hercules Computer Technology.
AST is a registered trademark of AST Research, Inc.

Inquiry 60


1-2-3
More than the best selling PC software
1982
1-2-3
intro
1984
1-2-3
The Standard
1986/87
1-2-3
A System
New Lotus products -
Lotus HAL,
Freelance Plus, etc.
independent software developers

1-2-3® is more than just the best selling PC software package in the world. It's a system. A system that includes a wide range of Lotus® products that work with 1-2-3. Including Lotus HAL™—for easier and faster use of 1-2-3. 1-2-3 Report Writer™—for reports, forms and mailing labels. And Freelance® Plus—for business graphics.

It's also more than 1000 specialized applications designed by independent software developers to work with 1-2-3.

It's outstanding support and service backed by a free telephone hotline and Lotus PROMPT™, a new comprehensive user support program.

But most important, it's a guarantee that the 1-2-3 software you buy today will become more valuable and more useful to you in the years ahead.

Lotus 1-2-3

Business software integrating spreadsheet, graphics and database.

© 1987 Lotus Development Corporation. Lotus, 1-2-3 and Freelance are registered trademarks of Lotus Development Corporation. 1-2-3 Report Writer, Lotus HAL and Lotus PROMPT are trademarks of Lotus Development Corporation. Lotus HAL is distinguished from HAL, which is a trademark of Qantel for its Hotel and Leisure Software.

new support/service
training centers
800 #



Inquiry 356 for End-Users.
Inquiry 357 for DEALERS ONLY.

THE MODEM FOR PEOPLE WHO TAKE THEIR ACT ON THE ROAD.



When you travel with your portable computer, make sure your communications go with you. The WorldPort 1200™ Portable Modem is the only modem you need, whether you travel across the country or around the world.

While most portable computers offer an optional modem of some type, only the WorldPort 1200 gives you all the features required for true portability. Features like battery-powered, Hayes™ Command Set compatibility, Bell and CCITT standards, direct and acoustic cups interface for 300 and 1200 bps, and compact size.

Equally at home on your desktop, the WorldPort 1200 works with virtually any computer with a RS-232C serial port. No more of those dedicated internal modems that can only be used with one computer.

The WorldPort 1200. At only $199, you can't afford to leave home without it.

For more information or your nearest dealer, contact us today.

TOUCHBASE SYSTEMS, INC.
16 Green Acre Lane
Northport, NY 11768
(516) 261-0423
Telex 6502848020

Hayes is a registered trademark of Hayes Microcomputer Products, Inc.

Items Discussed

EGA Paint $79
RIX Softworks
18552 Macarthur Blvd.
Suite 470
Irvine, CA 92715
(714) 476-8266

Multiscan Monitor $945
Sony Corporation
Sony Drive
Park Ridge, NJ 07656
(800) 222-0878
(800) 222-0879 in New Jersey

PC's Limited 386 System .Price not announced
PC's Limited
1611 Headway Circle, Building 3
Austin, TX 78754
(800) 426-5150

Relay Silver (micros only) $150
VM Personal Computing
41 Kenosia Ave.
Danbury, CT 06810
(203) 798-3800

TravelComm 1200 .....$124
Touchbase Systems Inc.
16 Green Acre Lane
Northport, NY 11768
(516) 261-0423

WordStar $350
MicroPro International
33 San Pablo Ave.
San Rafael, CA 94903
(415) 499-1200

ZA-181-5 Modem for the Z-181 .$399
Zenith Data Systems
1000 Milwaukee Ave.
Glenview, IL 60025
(312) 391-7000

out, isn't unusual, since not many others did either. After two hours with Ken Williams, I still don't know all I should, but I know more than I did.

First, not all PC-compatible programs can run under a virtual operating system (VOS). Many can. The advantage of a VOS is that it not only allows your 386 to run just about all the commercial software available for PCs and ATs, but it will run several of those programs at the same time, which is to say allow them to be truly concurrent.

We don't have that now. We have terminate-and-stay-resident (TSR) programs like SideKick and SuperKey and Ready!, which sit up in high memory. A sort of primitive monitor program (the kind of program we used to call a demon) watches for a special keystroke such as Alt-/ every time you strike a key. (This slows your machine down a bit, but not enough that anyone will ever notice.) When the demon sees that special keystroke, it takes over your machine. The demon saves off all registers and the stack and anything else he needs in order to put the machine exactly back the way it was when you pressed that key, then calls for his big brother the TSR program. This happens so fast you hardly notice. You then use SideKick or Ready!, and when you're done you exit; the TSR program calls the little demon, and he puts the machine back the way it was when you started.

Note, though, that you haven't really run two programs at once. If you had a fast enough machine, you could have accomplished the same result by saving whatever you were working on and loading in a new program.

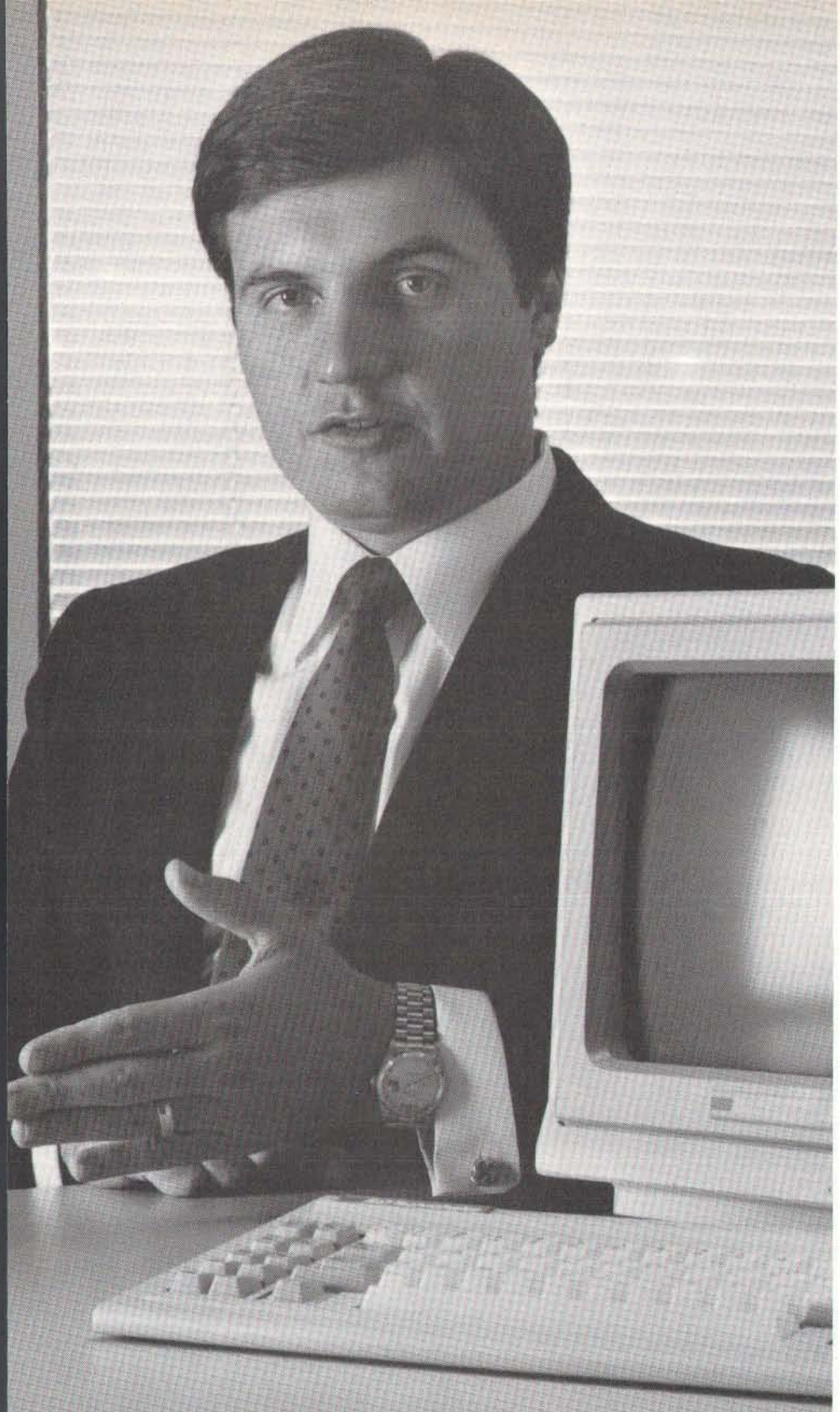
Truly concurrent systems work differently. You could, for example, have a big spreadsheet that takes 10 minutes to recalculate (given the speed of a 386 that's going to be a *big* program, but what the heck). You can leave that running, go out to the virtual operating system, and call up a brand-new DOS; and under that you can load in another Lotus 1-2-3, or a word processor, or even Flight Simulator.

More than that: you could, under the VOS, call in an entirely different *kind* of operating system, such as Pick, or UNIX, or even the kind of thing Niklaus Wirth designed for Lilith, assuming that anyone can get the Modula operating system going on an 80386. You could even have all of them running at once, and each would have the full resources of the entire system. Actually, of course, each OS only *thinks* it has the system's full resources; but through the magic of swapping things in and out of both hard and RAM disk, the program never knows that it's sharing resources with something else.

That's the good news.

The bad news is that not all existing programs are "virtualizable," and existing virtual operating systems can't do much about the dreaded 640K-byte memory boundary that plagues us. Serious copy-protection schemes (Softguard says "We

continued



Dimitri Rotow, President
BELL TECHNOLOGIES

NIX is a registered trademark of AT&T

"Microport is the *fastest* path between *real* UNIX® System V and you."

Dimitri Rotow runs a company on the go. He has little time for hardware or software that doesn't do the ultimate job for his company's customers.

Two months ago he assessed three readily-available UNIX (and UNIX-like) operating systems. After evaluating pricing, packaging, documentation, quality, service, manufacturer's support, compatibility, third-party support, features, conformity and performance, he and his VP of engineering came to one conclusion: "To praise Microport is to praise the AT&T/Intel joint venture, because Microport's version of UNIX System V is virtually *identical.* However, more *value* is received since more middlemen are removed—that's much closer to buying direct and selling direct."

Bell Technologies' customers appreciate real value plus real System V. If you're an OEM, a reseller, an end-user or simply curious about our product—call us today and see what all the endorsements are about.

Microport Systems, Inc.
10 Victor Square
Scotts Valley, CA 95066

408/438-UNIX (438-8649, local)
800/822-UNIX (Inside California)
800/722-UNIX (Outside California)
FAX: 408/438-2511
Telex: 249554

MICROPORT

Team Use for The AT.

Inquiry 190

have some knowledge of that phenomenon") can drive a VOS mad. There are other limits.

The bottom line, though, is that a good VOS can make a multitasking system out of any PC retrofitted with a 386 board; Orchid, Paradise, Intel, and a bunch of others are already selling 386 boards for ATs and compatibles.

Softguard expects to be shipping developer kits well before you read this. Hackers should find them interesting. The Softguard people mostly come from a mainframe tradition. They see a lot of "truly heroic code" out in the mainframe world that almost no one in the micro world is even aware of; and they're trying to bring some of that to the 386.

Me, I wish them well.

Winding Down

I'm about out of space and I haven't even mentioned the trip to France, where I spoke to executives of Sperry Networking and their guests. Sperry has recently merged with Burroughs into a company called Unisys, but it was still Sperry when I was there.

One of my fellow speakers was David Brunnen of Britain's Network Nine. This is a new venture from the denationalized British Telecom. They're doing some really spectacular things combining office rentals and communications systems.

Brunnen recalled that in the late 1960s he pulled the plug on one of the last manual switchboards in England. It was replaced by an automatic system. As he stood there behind the operator waiting for zero hour, a call came in. The operator listened for a moment and said, "Oh, it's no use ringing the vicarage, love, I'll put you through to the butcher shop." She'd just seen the vicar walk past. A few minutes later Brunnen pulled the plugs. Now, he said, 20 years later, the technology is just beginning to be able to deliver that level of service.

The book of the month is by Seymour J. Deitchman, *Military Power and the Advance of Technology* (Westview Press, 1983). A sound analysis, and I'm folding some of it into my revised *Strategy of Technology.*

The game of the month has to be Starglider for the Atari ST. Incidentally, the Atari ST was the real hit of COMDEX; their booth was jammed from the first day to the last, and some of the new software for the ST is really impressive.

I'll have more about COMDEX next time. I'm still looking for a good 15-inch color monitor that can take both EGA and CGA output. Now that both Sony and NEC have 13-inch systems that can do that (the Multiscan and MultiSynch, respectively), I don't think a big-screen multiple synchronous monitor will be too long in coming. Incidentally, RIX Softworks' EGA Paint program will knock your eyes out on the new Sony monitor.

Meanwhile, the refurbished Golem has arrived, and Tony Pietsch is coming over to install it. My anthology went out today, and this column is done. I have the Omni-Tel modem for the Z-181, and it can't be long before I have documents and software for it. The Zenith AT is coming, and for that matter I should have a new controller for Big Kat by the end of the week, and before then I should have Volume III of *Janissaries* done.

With luck the curse is ended. ■

Jerry Pournelle welcomes readers' comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE. One Phoenix Mill Lane, Peterborough, NH 03458. Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply.

FORTRAN PROGRAMMERS

Looking for the right PC FORTRAN language system? If you're serious about your FORTRAN programming then you should be using F77L - LAHEY FORTRAN.

"Lahey's F77L FORTRAN is the compiler of choice. It's definitely a 'Programmers FORTRAN,' with features to aid both the casual and the professional programmer. . . F77L compiled the five files in a total of 12 minutes, which was 4 times as fast as MS FORTRAN and an astounding 6 times as fast as Pro FORTRAN!" - PC Magazine

Compare the features and performance of other PC FORTRANs with F77L and you will find that F77L is clearly the superior product.

- Full Fortran 77 Standard (F77L is not a subset)
- Popular Extensions for easy porting of mini and mainframe applications
- COMPLEX*16, LOGICAL*1 and INTEGER*2
- Recursion - allocates local variables on the stack
- IEEE - Standard Floating Point
- Long variable names - 31 characters
- IMPLICIT NONE
- Fast Compile - Increases productivity
- Source On Line Debugger (Advanced features without recompiling)
- Arrays and Commons greater than 64K
- Clear and Precise English Diagnostics
- Compatibility with Popular 3rd Party Software (i.e. Lattice C)
- Easy to use manual
- Technical Support from LCS

• *NEW FEATURE - NAMELIST*

F77L - THE PROGRAMMER'S FORTRAN

$477.00 U.S.

System Requirements: MS-DOS or PC-DOS, 256K, math coprocessor (8087/80287)

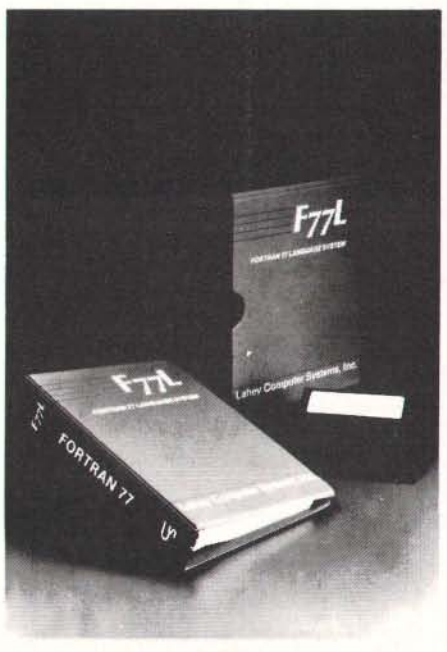
FOR MORE INFORMATION: (702) 831-2500

Lahey Computer Systems, Inc.
P.O.Box 6091
Incline Village, NV 89450
U.S.A.

International Dealers:
England: Grey Matter Ltd., Tel: (0364) 53499
Denmark: Ravenholm Computing, Tel: (02) 887249
Australia: Computer Transitions, Tel: (03) 537-2786
Japan: Microsoftware, Inc., Tel: (03) 813-8222

SERVING THE FORTRAN COMMUNITY SINCE 1967

MS-DOS & MS FORTRAN are trademarks of Microsoft Corporation.Pro FORTRAN refers to Professional FORTRAN a trademark of International Business Machines.



Editor's Choice
- PC Magazine

Inquiry 161

© Eastman Kodak Company, 1986

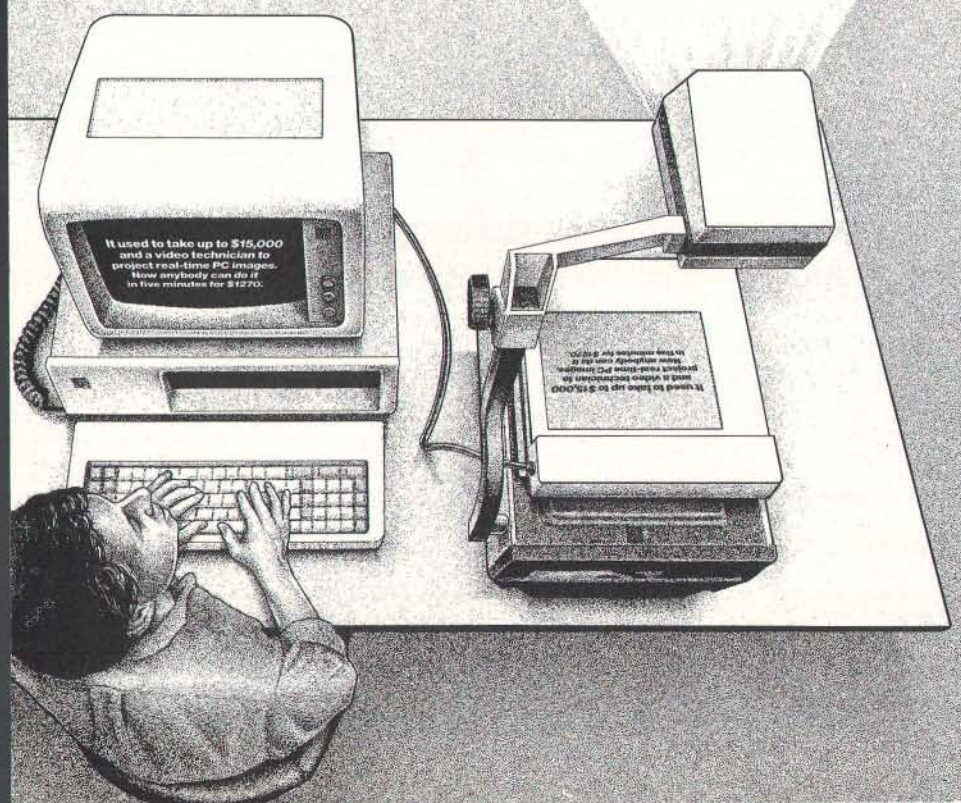
It used to take up to $15,000 and a video technician to project real-time PC images. Now anybody can do it in five minutes for $1270.*

1.
Plug the unit into your PC.
2.
Place it on your overhead projector.
3.
Begin your real-time presentation.

New KODAK DATASHOW System

Just think of all the applications.
Call for details:

1 800 44KODAK, Ext 865
(1 800 445-6325, Ext 865)



The DATASHOW System is used with an IBM PC or 100% compatible computer.
*Price shown is Kodak's suggested price only. Actual selling price is determined by dealer.

Kodak

Eastman Kodak Company
Motion Picture and
Audiovisual Products Division

Inquiry 97

The Small Office LAN

User-Friendly, Full-Featured, 6-PC Networking Solution Only $149.50 per PC Complete.



Laser Printer

RJ 11 Y-connector

Standard phone wire

TRUE NETWORK PERFORMANCE

1. **Peripheral Sharing:** enables up to 6 PC users to share laser or impact printers and storage devices.
2. **Runs 99% of MS-DOS Software*:** lets you share software you already own for word processing, accounting, database, spreadsheets, CAD/CAM, etc. (PC, XT, AT and compatibles).
3. **Transparent Natural Use:** allows direct access to remote files and programs on remote PC's. You don't have to leave your application and use a special program to copy files to your PC.
4. **Print Spooler:** lets you continue using your PC while your data is being printed or waiting to be printed. You use your present printing commands to automatically send your data to the printer.
5. **Fault Tolerance:** Software is resident on all networked PC's so any PC can be turned off or fail without interrupting network operations.
6. **Security:** Network users can be restricted from using printers, and reading or writing to designated storage devices.

USERS REPORT

Bechtel Power Company:
Tai Leong, Senior Engineer — "Because of our application it was essential to have a transparent network . . . The Knowledge Network's easy to use and its programability satisfies all our networking needs."

Holiday Inn, Corporate Headquarters:
Ben Holcomb, Director of Finance and Planning of International Hotels — "The Knowledge Network is an exciting product for the price . . . in fact, we're encouraging other Holiday Inn branches to use it."

Quantitative Software Reports:
Jay Siegal, Managing Director — "The Knowledge Network offers the minimal amount of disruptions to my complex programs . . . No hardware needed, no new commands . . . it meets my networking needs perfectly."

InsMark:
Max Dunn, System Manager — "It's our number one choice among software LAN's that we've reviewed. It's ideal for sharing disks, virtual drives and our other costly peripherals."

FEATURES

- **Guaranteed:** If you're not satisfied, return the product within 60 days for reimbursement.
- **Complete:** comes with everything: software, Network Controllers, phone wire and RJ 11 connectors.
- **Proven:** more than 800 satisfied Knowledge Network users.
- **Easy Installation:** user installable in 10 minutes. Network Controller connects to RS232 serial port using standard telephone wires and jacks. All PC's networked in parallel on a single "party line."
- **Low Complete Cost:** best price/performance ratio in PC networking: $299 for the two PC Starter Kit and $149.50 per Add On Kit. No networking boards, file servers, dedicated computers, dumb terminals or additional bridge software is necessary.
- **No Learning Curve:** uses standard MS-DOS commands.
- **Fast:** operates at up to 115,200 bps and uses automatic error correction Ethernet-like system (CSMA CD/CA).

Network Controller (plugs into RS232 serial port in each PC)



Applied Knowledge Groups, Inc.
1095 E. Duane Ave.
Suite 203
Sunnyvale, CA 94086
(408) 739-0300



Harry Coin, designer of the Knowledge Network:
"It's a low-cost, complete network. You don't have to learn new commands, or buy special network programs to get the job done."

THE KNOWLEDGE NETWORK

2 PC Starter Kit $149.50 × 2 = $299 (2 RS232 Network Controllers, phone wire, RJ 11 connectors, software and manual) _____

1 PC Add On Kit $149.50 each (1 RS232 Network Controller, phone wire, RJ 11 connector, software and manual) _____

Shipping & Handling (Allow 10 days for delivery) 10.00

Sub total _____

CA residents add applicable sales tax _____

TOTAL _____

Payment or Charge: __VISA __MC __AMEX __Check

1-800-443-1254

1-800-422-1254 in CA

NOT COPY PROTECTED

*MS-DOS (from V 2.0 and up), Lotus 1,2,3, dBASE (II & III +), Wordstar, Word Perfect, Word, Sidekick, Reflex The Analyst, AutoCAD, etc. Supports plotters.
AutoCAD is a registered trademark of Autodesk, Inc. dBASE is a registered trademark of Ashton-Tate. IBM PC, XT, AT are registered trademarks of International Business Machines Corp. WordPerfect is a registered trademark of Satellite Software International. Lotus 1,2,3 is a registered trademark of the Lotus Development Corp. Wordstar is a registered trademark of MicroPro. Ethernet is a registered trademark of the Xerox Corp. Word and MS-DOS are registered trademarks of the Microsoft Corp. SideKick and Reflex The Analyst are registered trademarks of Borland International, Inc.

Inquiry 25

Status Report

Ezra Shapiro

Confession time finds Ezra telling which products he uses regularly

When I began writing Applications Only a year ago, I promised to be honest about my prejudices. I think it's important for a reader to know what software a reviewer uses on a day-to-day basis; personal work habits affect program evaluations far more than writers usually care to admit. I'm hoping that if you know what I like, you'll have a better chance of determining how my preferences match up with yours. So I've stuck two sections of true confessions to the end of this column.

But first, a couple of new products.

Rags or Riches?

I have mixed feelings about **Ragtime** (Orange Micro, $395) for the Mac, a novel blend of spreadsheet, word processor, and page layout program. I like the program a lot, but it has some holes I find disturbing. Because it allows you to combine active spreadsheet and text sections anywhere on a page, Ragtime is extremely good at forms design. But like most other integrated software packages I've tried, Ragtime's parts start looking shabby when you compare them to equivalent standalones. I don't mean to suggest that Ragtime isn't pretty amazing—it is—but it lacks a few features that would make it much better at what it's supposed to do, which is a shame.

The central element of the package is the page layout module, and it's here that Ragtime really shines. You create "frames" on a page by dragging the mouse, as you would to construct a hollow rectangle with a graphics program. Any frame can contain text, a spreadsheet, or imported MacPaint or PICT artwork. What's more, frames can be nested, so, for example, spreadsheets can live within text frames. If you're working with text, you can construct a "pipeline" between the two frames by simply drawing a connecting line. This is all very easy, and the program provides an informative status box anytime you're creating, resizing, or moving frames. Ragtime automatically numbers frames in order of creation, and you can choose to display or hide the number tags with one menu selection. Spreadsheets can reference cells in other frames using these tags.

The word processor in Ragtime is page-oriented; if you want to write something that's longer than a single page, you have to stop and create a new frame for the continuation. However, once you've linked pages, changes flow magically through the pipeline and the text reforms to fit. When you resize a frame, the speed with which Ragtime processes the change is impressive. The spreadsheet is a solid basic engine with a large selection of built-in functions (but no macros), and graphics import allows cropping and quick rescaling of images.

The components work well together, and creating business forms is easier than it has ever been. While you can't quite have spreadsheet data floating within a text paragraph—frames remain fixed until you move them—you can shrink a spreadsheet frame down to a single, naked cell. The program's potential is amazing. You can even save any document as a blank form, ready for reuse, without having to manually delete its contents.

So what's wrong?

Well, I can live without a spelling checker, and I can also live without automatic hyphenation. But how can a program that prides itself on fast text reformatting exist without any sort of soft hyphens? Any time you change the width of a frame, you've got to go in and painstakingly hyphenate, rehyphenate, or unhyphenate your text.

As to the spreadsheet, I can survive without macros and user-defined functions. But why are there no graphics? I find this omission truly bizarre; in order to construct a bar graph or pie chart, you've got to dump out your worksheet as delimited text, suck the data into another program, build the chart, save it on the clipboard, go back to Ragtime, and so on. Very strange, especially for a program that's supposed to be the business person's answer to desktop publishing. I also would have expected the spreadsheet to be capable of importing either Excel or 1-2-3 worksheets; Ragtime reads only delimited text, so you lose your formulas.

I realize the program is pushing the Mac's CPU, but scrolling is choppy and not particularly fast. You could endure it, but it's on the outside limits of acceptability. There are also some minor bugs repainting the screen, but nothing that doesn't correct itself with the next command.

The reduced view, which displays a full page in miniature, is completely live. That's great for repositioning and resizing elements, but if you happen to click the mouse inside a frame rather than along its border, you're suddenly editing the frame's contents (which you can't see)—a big mistake that can happen easily.

The documentation is thorough but not outstanding, and the on-disk tutorial shows you how to produce yet another three-column newsletter. (Are other Mac owners getting as sick of these as I am? Seems like they come with every new program.) The press kit contains a full IRS tax form, complete with boxes and teeny type. "Wow," I thought. "I bet they'll show me how I can construct a self-calculating tax package." Wrong. The only sample you get is the newsletter.

Ragtime doesn't quite make up its mind what it's trying to be. Is it an all-purpose

continued

Ezra Shapiro is a consulting editor for BYTE. Contact him at P.O. Box 170040, San Francisco, CA 94117. Because of the volume of mail he receives, Ezra, regretfully, cannot respond to each inquiry.

integrated package, a page layout program with some extra features, or a forms design product? I just can't shake the feeling that Ragtime's authors lost track of their purpose along the way.

Spelling Demon

Write Now (Airus, $150) is a great little word processor for MS-DOS machines. It isn't the world's biggest or fanciest product, but I like it. If you don't need much more power than PFS:Write, Write Now is entirely adequate and packs some nifty unusual features to boot.

First of all, you don't get multiple-column formats, footnotes and tables of contents, sophisticated typesetting, outlining, or any of the features associated with industrial-strength word processing. You do get a solid editor that can handle a simple mail merge, basic layout (like headers, footers, and page numbers), cut and paste, a choice between function key menus and WordStar-like command sequences, and all the usual editing tools.

The neat stuff is in the area of spelling. If you ask it to do so, Write Now will check words as you type, beep at you, suggest correct spellings, and even complete words for you as soon as it identifies a unique entry in its dictionary. Or you can shut off any or all of the above and simply check an entire document anytime you want. In several weeks of testing, I noticed no degradation in speed as a result of the real-time comparisons.

My only quibbles are in the area of personal taste. I'd like a bigger dictionary, and I'd like to be able to shut off the status lines that clutter the top and bottom edges of the screen, and I'd prefer a larger file size than Write Now's limit of 64K bytes. But I found the program easy to learn and use, well designed, effectively documented, and all-around nice.

Once you accept that you're not getting MultiMate or Microsoft Word, you'll love this product. It's certainly a good choice as a basic editor, a first word processor, or a convenience if you're a rotten speller. Airus, the company that produces Write Now, listens to users and provides good support. I have no qualms recommending it to anyone.

Confession Time

The question I'm asked most frequently goes something like this: "Okay, Shapiro, I read what you had to say in your column, but what do you *really* use?" It deserves an answer. Bear in mind that I'm a freelance writer, editor, and graphic designer by trade; I'm not an engineer, accountant, or programmer (though I do dabble). That means I'm a heavy user of word processors and related tools, and I use spreadsheets and databases to run a very small personal business. Like most people, I'm also a creature of habit, and I'm lazier than I like to admit.

For the past year, my primary editor under MS-DOS has been Framework, chiefly because I love the spreadsheet and the windowing interface. When I have a complex project that requires fancy formatting, I confess I haul out good old WordStar 3.3, though heaven help me if I need footnotes. I've never been able to crash WordStar, and I learned to use it before anybody told me that it's difficult to master. I maintain that when the going gets tough, the tough use WordStar. I have tried, and failed, to shift my writing over to XyWrite, WordPerfect, Volkswriter 3, Microsoft Word, and PC-Write. Of the five, I'm most attracted to XyWrite; it's fast, powerful, and programmable, but I haven't had the energy to completely redefine the keyboard, which I'd want to do before making the switch. Walter Feigenson (formerly of NewStar, now of MicroPro) tells me that the new version of WordStar will ease my embarrassment over my old standby; I sure hope so.

continued

Do You Ever Get the Feeling That No One Speaks Your Language?

Arity/Prolog. The Language That Spans the Generation Gap.



Arity listens to what you ask for. You want a serious, versatile language that will go the distance for you. There are two very good reasons for you to use Prolog—to do your work smarter and faster. That's exactly what the Arity/Prolog development environment will help you do. Our powerful tools, based on the general purpose programming language Prolog, will significantly reduce your development time and allow you to solve a wide range of application problems.

No translation required Our development environment for the IBM PC family and all MS-DOS compatibles includes the Arity/Prolog Compiler and Interpreter, the Arity/Expert System, and Arity/SQL. And you can tie them all together. You can interface with several other programming languages and build extensions to your existing applications. You'll be truly multilingual—what better way to span the generation gap?

It can take you to new places You'll discover amazing speed, power, and flexibility using the Arity/Prolog programming environment, with its one gigabyte of virtual memory and fast, compact compiled code, for conventional applications. And if you're working in new territories, like expert systems or sophisticated database management systems, you'll be speaking the native tongue.

Speak it freely Our products are not copy protected and we charge no royalties, so you can use them in as many end-user applications as you'd like. Why keep the language of solutions all to yourself?

Join the thousands of assembly and C programmers who already use Arity/Prolog—the language of solutions.

Call 1-800-PC-ARITY Today.

Massachusetts residents call 617-371-1243.

Software that roars.

ARITY CORPORATION
30 Domino Drive, Concord, MA 01742 U.S.A.
1-800-722-7489 or in Massachusetts call 617-371-1243

Inquiry 28

What's New at
AMERICAN DESIGN COMPONENTS?

"The Source" of the electro-mechanical components for the hobbyist.

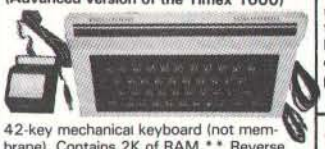
We warehouse 60,000 items at American Design Components — expensive, often hard-to-find components for sale at a fraction of their original cost!

You'll find every part you need — either brand new, or removed from equipment (RFE) in excellent condition. But quantities are limited. Order from this ad, or visit our retail showroom and find exactly what you need from the thousands of items on display.

Open Mon. – Sat., 9–5

THERE'S NO RISK.
With our full 90-day warranty, any purchase can be returned for any reason for full credit or refund.

PC 8300 HOME COMPUTER
(Advanced version of the Timex 1000)



42-key mechanical keyboard (not membrane). Contains 2K of RAM.** Reverse video, Z80A, 6.5 MHz processor, ROM 8K BASIC. Graphics capability/sound–music, TV or monitor. Joystick input operates on 115 VAC. Includes: AC adapter, TV cable, and pair of cassette cables. Will run all prerecorded tapes for Sinclair/Timex 1000-ZX81. Mfr — Power 3000.
Item #10336 **$29.95** New (in orig. boxes)

****16K RAMPACK upgrade**
(1 available per each customer.)
Item #10337 **$10.00** New

3½", 10Mb HARD DISK DRIVE (IBM® Compatible)



Fits standard 5¼" spacing. Shock mounted. High speed, low power. Mfr — MMI #MM212
Item #9217 **$179.00** New
Controller Card for above
Item #9984 **$99.00**

ADAM COMPUTER KIT! *(Less printer & w/o cabinet)*



Build it yourself from subassemblies. No wiring nec. (just plugs together). Hook-up diagram included. Includes: Keyboard, 1 cassette digital data drive, 2 game controllers, power supply, all memory boards, and one cassette. Capable of running CP/M, has built-in word processor. Item #7410
Complete — **$99.00**

ADAM PRINTER



Complete, less top cover plate. Friction feed. Takes standard paper 8½" x 11". (Customer returns; tested — operational.)
Item #8839 **$69.50**

5¼", 1.2 Mb. AT HALF HT. DISK DRIVE



48/96 TPI (IBM® Compatible)
Double sided, single/double density; 80 track.
Mfr — Panasonic #JU-475
Item #10005 **$129.00** New

COLECOVISION to ADAM EXPANSION KIT



This expansion module just plugs into your ColecoVision. With Printer Power Supply and data drive (both included), you will have a working Adam Computer. Adam Keyboard, one Smart basic cassette and hookup diagram also included.
Item #9918 **$59.50**

ADAM ACCESSORIES...

DATA DRIVE
Item #6641 **$9.95**

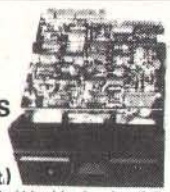
PRINTER POWER SUPPLY
Item #6642 **$14.95**

ASCII KEYBOARD
Item #6643 **$19.95**

CONTROLLERS (set of 4)
Item #7013 **$9.95**

ASSORTED CASSETTES
Item #7786 **$19.95**

5¼" FULL HT. DISK DRIVES 48 TPI (IBM® Compat.)



Double sided/double density, full height drive. 48 T.P.I., 80 tracks.
Mfr — MPI-52S
Item #7928 **$79.95**
2 for $150.00

96 TPI, DS/Quad Density
Mfr — CDC #9409T
Item #1893 **$99.00**

MECHANICAL KEYBOARDS



48-KEY — Timex Z81/1000
Item #6712 **$5.95** New

66-KEY — Commodore C-16
Item #9394 **$5.95** New

75-KEY — Timex or Adam
For computer upgrade...
Item #7429 **$5.95** New

CORDLESS TELEPHONE



700 ft. Range
Wall or Base Mount

Full duplex: talk & listen simult. Auto redial: last number dialed recall. Comes with attachments for both types of mtg.; incl. AC power adaptor & battery indicator light. Color: brown w/cream. Famous make mfr.
Item #9997 **$29.95** New

Power Supplies

190W DISK DRIVE POWER SUPPLY



Input: 115V
Output: +12V @ 4.13A, +5.1V @ 3.04A } x 3
Contains 3 sets of dual outputs, allowing for simultaneous operation of 3 disk drives. Originally designed for the AT & T computer.
Dim.: 11"W x 4½"H x 7"deep
Item #10006 **$59.95** New

HI-POWER SWITCHING POWER SUPPLY



Output: +5.15V @ 70A
+12V @ 4A
+12V @ 4A
+5.2V @ 5A
Input: 115/230V nominal, .725KW cont. 47–63Hz. Enclosed in metal housing.
Dim.: 15"W x 2½"H x 6" deep.
Mfr — Todd Prod. #4XS8151A
Item #9749 **$29.95** New

COMPUTER GRADE POWER SUPPLY



Other uses–runs CB & car radios. Comes ready to plug in!
DC Output: –5V @ .5 amp.
+5V @ 3 amp.
+12V @ 6 amp.
Input 115V/60H. Dim.: 9¼"W x 3¾"H. (Rubber ft. incl.)
Item #9501 **$24.95** New

Composite Video Monitors

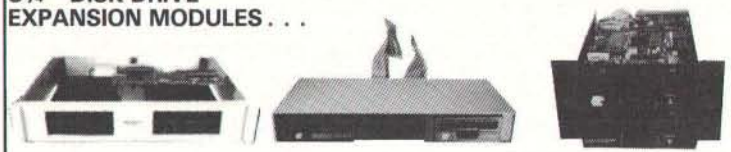


12" Monitor
(Controls front panel mounted)
12", green phosphor, high resolution (12 lines center) and bandwidth from 10Hz to 30Hz ± 3dB. Op. volt.: 120/240VAC, 50/60Hz., 65VA max. Controls front panel mtd.
Mfr — Motorola – Alpha Series
Item #10043 **$29.95** New

15" Monitor
15" screen. Same specs as above.
Item #10044 **$34.95** New

PUMPS—COMPRESSORS—BLOWERS—MOTORS—POTENTIOMETERS—COUNTERS TIMERS—RELAYS—VOLTAGE REGULATORS—POWER SUPPLIES

3¼" DISK DRIVE EXPANSION MODULES...



IBM PC Jr.
Side-by-side mounting (PC Jr. mounts on top). With floppy disk drive controller board. Contains: 2 Tabor TC-500 3¼" disk drives. Total capacity 360K. Item #8825
~~$199.00~~ **$99.00** New

APPLE
Side-by-side mtg. with disk storage space in front. Floppy disk controller board capable of handling 4 disk drives. Contains: 2 Tabor TC-500 3¼" disk drives. Total cap. 360K.
Item #8826
~~$199.00~~ **$99.00** New

IBM PC/XT
Stacked mounting, replaces old-fashioned 5¼" disk drives. Contains: 2 Tabor TC-500 3¼" disk drives. Total capacity 360K. Plugs right into your controller.
Item #8827
~~$169.00~~ **$99.00** New

Each unit supplied with two 3¼" flexible diskettes.

IBM® COMPATIBLE 3¼" DISK DRIVE



Tabor TC-500 drivette. Single-sided, quad density.
Capacity: 164K bytes. Will work with any 5¼" disk controller.
Item #8824 ~~$79.95~~ **$49.95** New
*Total cap. 500K bytes with special software.

3¼" DISKETTES (Pack of 5)
Item #9495 **$9.95** New

MINI MICROCOMPUTER REGULATOR



140 VA

Provides voltage regulation and ultra-isolation for microprocessor-based equipment. Contains less than 3% harmonic distortion, better than 60 dB traverse noise rejection. Contains dual outlet for CPU & monitor, and 6 ft. line cord.
Input: 95 — 130V, 60Hz.
Output: 120V @ 1.17A
Dimensions: 11⅞"L x 4⅜"H x 5⅝"W
Mounted on metal base with rubber feet.
Mfr — Sola #63-13-114
Item #9999 **$99.00** New

AMERICAN DESIGN COMPONENTS, 62 JOSEPH STREET, MOONACHIE, N.J. 07074

YES! Please send me the following items:

Item No.	How Many?	Description	Price	Total
			Total	
		Shipping & handling, we ship UPS unless otherwise specified. Add $3 plus 10% total. Canadian: $3 plus P.O. cost. Charge only.		
		Sales Tax (N.J. residents only, please add 6% of total)		
			ORDER TOTAL	

FREE 1987 CATALOG sent with every order.

☐ My check or money order is enclosed.
☐ Charge my credit card.
☐ Visa ☐ Master Card ☐ Amex

MINIMUM ORDER $15.

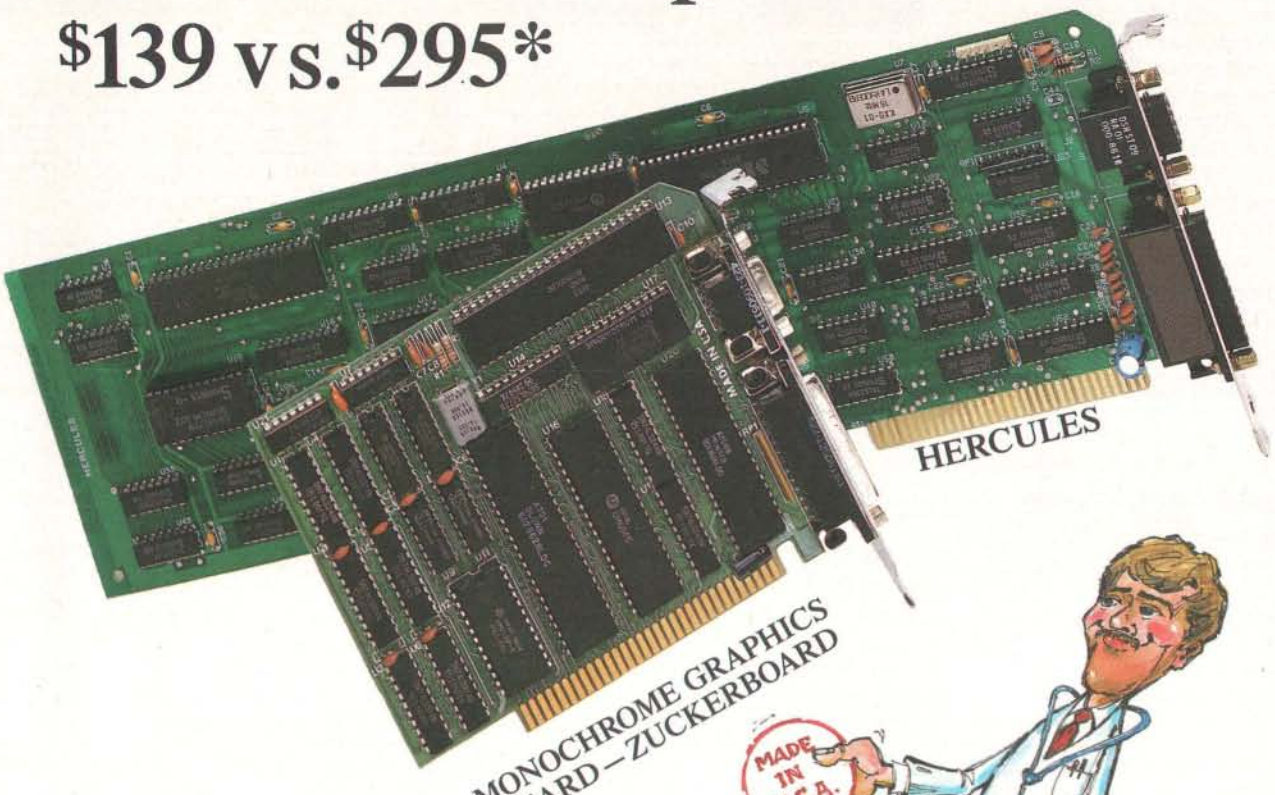
Byte-37

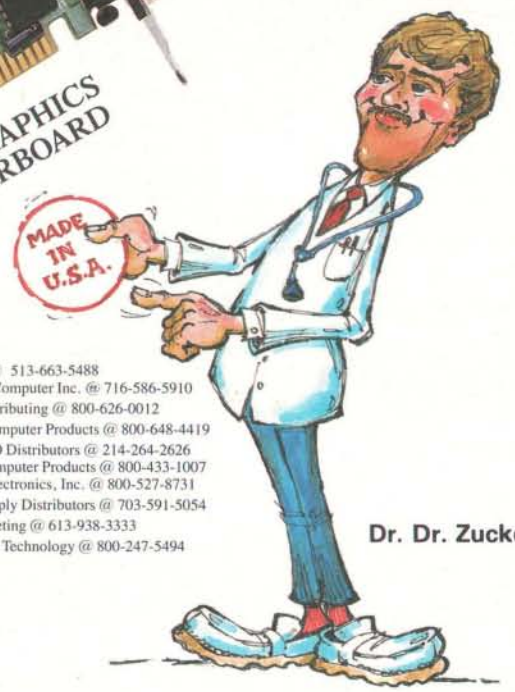
Card No.
Exp. Date
Signature
Telephone: Area Code Number
Name
Address
City
State Zip

All inquiries and free catalog requests call 201-939-2710.

For all phone orders, call **TOLL-FREE 800-524-0809.** *In New Jersey, 201-939-2710.*

½ Size, ½ Cost & Not A Clone! Monochrome Graphics ½ Card — $139 vs. $295*





Dr. Dr. Zucker

In California Call:	Kenfil Software @ 800-662-0505
In Colorado Call:	Micro Data Products @ 303-360-6200
In Florida Call:	First Source @ 305-648-0501 O'Toole Interprises @ 800-558-9379 P.C. Distributors @ 800-428-1888
In Georgia Call:	Majors Distributing @ 404-454-8281 Ashford International @ 404-939-7533
In Illinois Call:	Comark, U.S.A. Flex @ 800-323-6135 P.C. Distributing @ 312-298-1400 State Wide @ 312-932-0890
In Massachusetts Call:	J.H. Lawrence @ 800-221-3328
In New York Call:	Great Lakes Distributing @ 716-691-8981 KBL Marketing @ 516-434-9010 Manchester Equipment @ 516-435-1199 Micro-Buy @ 516-420-1633
In Ohio Call:	Infotel @ 513-663-5488 Amdex Computer Inc. @ 716-586-5910
In Connecticut Call:	P.C. Distributing @ 800-626-0012
In Tennessee Call:	Multi Computer Products @ 800-648-4419
In Texas Call:	Compu D Distributors @ 214-264-2626 Hiltz Computer Products @ 800-433-1007 Vidco Electronics, Inc. @ 800-527-8731
In Virginia Call:	TCS Supply Distributors @ 703-591-5054
In Canada Call:	JB Marketing @ 613-938-3333
In Pennsylvania Call:	People & Technology @ 800-247-5494

It's another ZUCKERBOARD

235 Santa Ana Court • Sunnyvale, CA 94086
(408) 720-1942 • 1-800-458-6200 CA • 1-800-624-4920 US

Hercules is a trademark of Hercules Computer Technology, Inc.
*Average price of 400 dealers according to June 1986, survey by Store Board Inc., Dallas, Texas
ZUCKERBOARD is a registered trademark of Advanced Transducer Devices, Inc.

I use Instant Recall (the pop-up free-form text database) constantly; it has replaced Borland's Reflex as my database of choice, though I still use Reflex when I have to accomplish structured analytical tasks. I load Ready! every time I need to generate an outline, and I run SideKick only when I need an ASCII table. I've become addicted to Cruise Control for precision cursor control; every time I remove it to test another terminate-and-stay-resident program, I find myself missing it. For telecommunications, I use Mirror because it can transfer in the background and because I'm familiar with the Crosstalk interface. If I had to construct heavy-duty spreadsheets and databases, I'd use VP-Planner and Paradox.

Over on the Macintosh, I began using Microsoft's Works as an interim solution while waiting for final copies of Word 3.0 and Excel 1.03, and I've been surprised at how much time I'm spending with it. I gnash my teeth at its many limitations (for example, who ever heard of a database without a "logical flag" field type?); but I use it for just about everything, though I expect to move my writing to Word 3.0 when it gets here. I use More when I'm developing anything for which outlining is appropriate. For telecommunications, I find Works barely adequate (no macros, but I can upload a document without having to convert it to ASCII text). When I'm downloading binary material, I use two simple but effective shareware packages, MockTerminal and BackDown. Both are desk accessories; MockTerminal dials and establishes contact, and BackDown is an XMODEM downloader that operates in the background, so I can keep working during the transfer. I use both SuperPaint and GraphicWorks, and my current love is Fontographer, a typeface design program from Altsys.

I'm not yet as firmly entrenched on the Mac as I'd like to be, so I'm still not ready to vote in several categories. Reflex for the Macintosh and Omnis 3 are battling it out in the database management arena, and PageMaker and Ready,Set,Go! 3 are running neck and neck for layout. I've also been toying with building my invoicing system into Ragtime.

Please note that I'm not endorsing any of this stuff; it's merely what I use. Choosing software is a very personal process; what's right for me may not be right for you. And there are scads of excellent programs out there.

Hardware

The second most popular question I'm asked is, "What equipment do you recommend?" That one's a toughie because I'm a consumer with a limited budget just like anybody else. So I can't make any official comparisons, but here's a rundown of what I own.

I've got an "ancient" Compaq portable equipped with a loaded AST Six-Pak Plus, an NEC V20 CPU, an 8087-2, and a Fast88. (I've received a lot of mail since I mentioned the Fast88 in my column last October. It's a miniboard that gives me a clock speed of 4.77 or 8 megahertz, switch- or software-selectable. I'm hoping it will delay the inevitable purchase of a 286 or 386 machine by a few more months. Great product.)

My hard disk is a grubby external 30-megabyte box, with a grinding drive from Tandon (sold to me as a 35-millisecond unit, but it's never run faster than 50 to 60 milliseconds). I use a Logitech C7 serial mouse. My Macintosh is a Mac Plus with a DataFrame 20 SCSI external hard drive; no problems there. My Tandy TRS-80 Model 100 has 32K bytes of RAM and an Ultimate ROM II from Traveling Software.

I own three modems, all external: a Hayes 300, a Prometheus 1200, and a U.S. Robotics Courier 2400. All have per-

continued

When You're Looking for Answers, Come to the Library

10 MHz AT Compatible System

Complete Monographic System with Monitor and Display card

Designed, Manufactured, and Serviced in U.S.A.

Runs Xenix™ Auto Cad Novell Network

- 67% faster than IBM AT
- 80286, 10 MHz CPU
- 512KB memory
- Fully IBM compatible BIOS
- CMOS clock/calendar
- 200 watt power supply
- AT style keyboard
- Operation Manual

FCC Class 'B' approved
One Year Limited Warranty

Free Starter's Kit:
- DOS 3.1
- 3 Diskettes
- Diskette case

$809 Basic System

Option:
1.2MB Floppy drive
WD HD/Floppy controller
Hercules Compatible card
High Resolution mono monitor $1375

EGA System with EGA monitor and EGA card $1850

System without Mono monitor and Video card
8 MHz $1029
10 MHz $1129

Monitor not included

8 MHz Turbo XT System

- Fully IBM compatible
- 8088-2 8 MHz CPU
- 4.77 & 8 MHz keyboard selectable
- 360K floppy drive
- Floppy drive controller
- 256K memory expandable to 640K
- Option Math Co-processor
- 150W power supply
- Keyboard

$475

FCC Class 'B' approved
One Year Warranty

Monitor not included

1/2 Ht. and Full Ht. Hard Disk

Seagate 20MB Subsystem $365
- ST-225 Drive
- Controller
- Cable and hardware
- Software and Manual

20MB ST-4026 $539
30MB ST-4038 $639
40MB ST-4051 $695
80MB ST-4096 CALL
- Cable, rails
- Software and manual

AT Multifunction $175
- Up to 2MB memory
- Selectable memory addressing
- Serial/Parallel/ Game ports
- Software

Everex Modem $128
- Half-size
- 300/1200 BAUD
- Fully Hayes comp.
- BITCOM communications software

2400 BAUD CALL

EGA Card $228
- Fully IBM EGA comp.
- Color/Mono display
- 16 colors from a palette of 64
- 640 x 350 high resolution graphics
- 256K Display memory

Mini I/O Card $59
- Parallel/Serial
- Clock/calendar
- Half-size card
- Cables

With Game port $68

Wangtek 60MB Tape Backup
INT $727 EXT $827
- Backup 5MB in 1 minute
- Image/file by file
- Mounting hardware
- Software and Tape

Others:
- AT Multifunction $175
- AT 3MB Memory Expansion card $150
- AT HD/Floppy controller $175
- PC Multifunction $94
- Multifunction/Mono card $139
- Expansion chassis $428
- Floppy controller $33
- EVEREX Edge $229
- DOS 3.1 $69
- 150 W power supply $79
- Keyboard AT/XT $75
- Mono/Color/EGA monitor CALL
- TEAC 20MB Tape backup $580
- Hercules compatible $98

Terms: We accept MasterCard, VISA (3% surcharge), COD's (Certified Funds) and Company/Institutional P.O.'s. California residents add 6.5% sales tax. For returns and repairs, call for RMA number. 15% restocking fee charged on unauthorized returns. Prices are subject to change without notice. BitCom, Hayes, Hercules, and IBM are registered trademarks of their respective companies.

COMPUTER LIBRARY
Sales (415) 659-8784
Tech Support (415) 659-8849
5349 Randall Place
Fremont, CA 94538
Quantity Discounts Available

Items Discussed

BackDown $30
Ron Risley
P.O. Box 1724
Orange, CA 92668

Cruise Control $29.95
Revolution Software Inc.
715 Route 10 East
Randolph, NJ 07869
(201) 366-4445

Excel 1.03 ..... $395
Word 3.0 (Mac) $395
Works $295
Microsoft Corporation
16011 Northeast 36th Way
P.O. Box 97017
Redmond, WA 98073-9717
(206) 882-8080

Fast88 ..... $149
MicroSpeed Inc.
5307 Randall Place
Fremont, CA 94538
(415) 490-1403

Fontographer $395
Altsys Corporation
720 Ave. F, Suite 108
Plano, TX 75074
(214) 424-4888

Framework II $695
Ashton-Tate
20101 Hamilton Ave.
Torrance, CA 90502
(213) 329-8000

Instant Recall $69
Precept
3790 El Camino Real, Suite 173
Palo Alto, CA 94306
(415) 327-6885

Mirror $69.95
SoftKlone Distributing Corporation
1210 East Park Ave.
Tallahassee, FL 32301
(904) 878-8564

MockPackage $35
(includes MockTerminal, MockWrite, MockPrinter, MockChart, and EZ-Menu)
CE Software
801 73rd St.
Des Moines, IA 50312
(515) 224-1995

More $295
Ready! $99
Living Videotext Inc.
2432 Charleston Rd.
Mountain View, CA 94043
(415) 964-6300

Omnis 3 Plus $495
Blyth Software Inc.
3655 Campus Dr.
San Mateo, CA 94403
(415) 571-0222

PageMaker $495
Aldus Corporation
411 First Ave. South, Suite 200
Seattle, WA 98104
(206) 622-5500

Paradox $695
Ansa Software
1301 Shoreway Rd., Suite 221
Belmont, CA 94002
(415) 595-4469

QMS PS-800 ..... $5895
QMS Inc.
1 Magnum Pass
Mobile, AL 36618
(205) 633-4300

Ragtime $395
Orange Micro Inc.
1400 North Lakeview Ave.
Anaheim, CA 92807
(714) 779-2772

Ready,Set,Go! 3 ..... $195
Manhattan Graphics
401 Columbus Ave.
Valhalla, NY 10595
(914) 769-2800

Reflex $149.95
Reflex for the Macintosh $99.95
SideKick (MS-DOS) $84.95
Borland International
4585 Scotts Valley Dr.
Scotts Valley, CA 95066
(408) 438-8400

Ultimate ROM II $229.85
Traveling Software
11050 5th Ave. NE
Seattle, WA 98125
(206) 367-8090

VP-Planner $99.95
Paperback Software International
2830 Ninth St.
Berkeley, CA 94710
(415) 644-2116

WordStar 3.31 ..... $350
WordStar Professional $495
MicroPro International Corporation
33 San Pablo Ave.
San Rafael, CA 94903
(415) 499-1200

Write Now $150
Airus Inc.
10200 Southwest Nimbus Ave., Suite G-5
Portland, OR 97223
(503) 620-7000

XyWrite III $395
XyQuest Inc.
3 Loomis St.
Bedford, MA 01730
(617) 275-4439

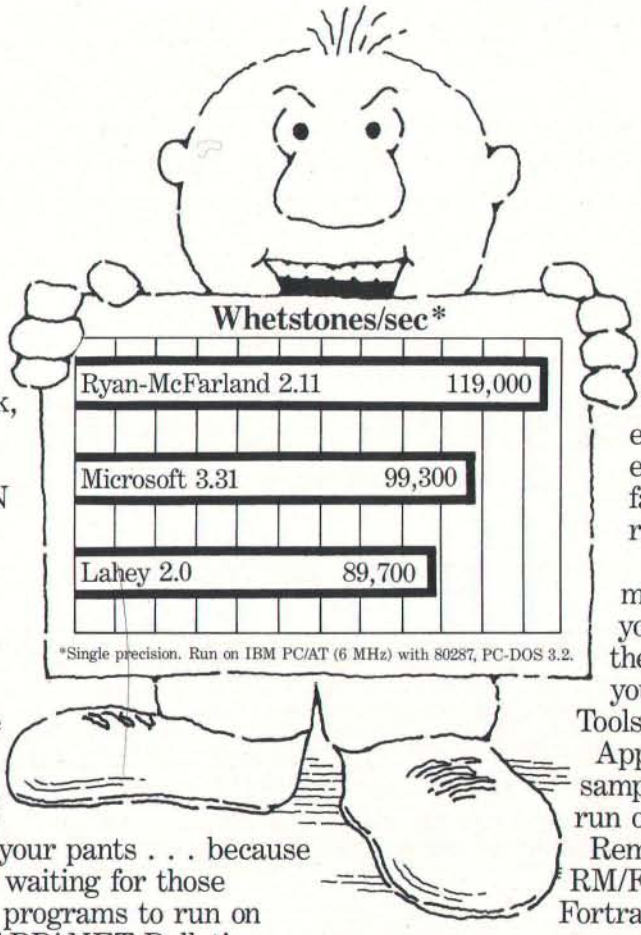
formed flawlessly. Checking my records, I realized that I paid almost exactly the same amount (about $400) for each of them, with a two-year gap between each purchase.

For printers I have an Okidata 192P with a cut-sheet feeder and a PS-800 from QMS (the PostScript laser printer). The Okidata has been a reliable little workhorse since it replaced a Mannesmann Tally a year ago. The PS-800 is wonderful. I've never had another laser printer, so I can't say how it stacks up against the competition, but I've had no trouble, and the laser output is spectacular. If you're looking for a hardware object of lust, I cheerfully nominate laser printers, and the QMS is a fine choice.

I own more cables than the average small public utility company.

That's about it. ■

KILLER FORTRAN.



This is the one.

Whatever the yardstick, RM/FORTRAN™ blows the others away.

Sieve? RM/FORTRAN runs 26% to 228% faster.

Whetstones? RM/FORTRAN is 20% to 33% better.

And those aren't our benchmarks. They're the industry standards.

With RM/FORTRAN, you can actually feel the difference in the seat of your pants . . . because you'll do less sitting and waiting for those big, complex mainframe programs to run on your micro. In fact, an ARPANET Bulletin Board user said, ". . . for serious conversion work of mainframe Fortran code, use the Ryan-McFarland . . ."

RM/FORTRAN is also the first and only PC Fortran GSA certified at Full Level ANSI 77 with no discrepancies. So programs move effortlessly from your mainframe to a PC, XT, AT or compatible. And they also port to 68000-based systems or new 80386 machines. You may already be using version 1.0 under the name "IBM PC Professional Fortran by Ryan-McFarland."

RM/FORTRAN comes with popular extensions from VAX, VS and Fortran 66. That's more mainline mainframe extensions than any other micro Fortran.

And there's more. PC TECH Journal, for example, said our "compiler's documentation, ease of use, speed of execution, and debugging facilities place it first for recommendation."

But why spend any more time reading when you should be filling out the coupon and getting your free "RM/FORTRAN Tools, Utilities and Applications Directory" and sample benchmark programs to run on your own PC.

Remember, if it isn't RM/FORTRAN, it's just a Fortran also-ran.

Ryan-McFarland
609 Deep Valley Drive
Rolling Hills Estates, CA 90274
or call 213-541-4828

RYAN-McFARLAND

B-3

Knock me out. Send me the benchmark programs and the free Applications Directory.

Name _____

Company _____ Title _____

Street _____

City _____ State _____ Zip _____

Phone ( ) _____

Inquiry 263

MASS STORAGE.....1987

AND MULTIFUNCTION CONTROLLERS

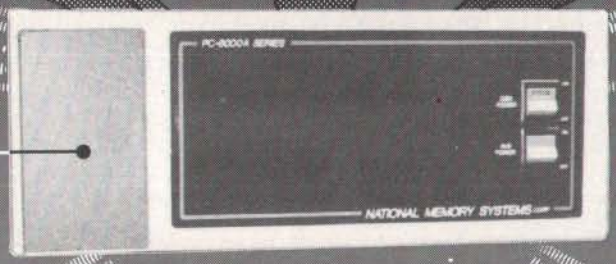
$10,900 = 510 MegaBytes

For All AT, RT, XT, PC and COMPAQ 386 Applications

$10,900 — 510MB

$8,900 — 374MB

$6,500 — 168MB



Optional integrated 60MB tape back-up $1,495

- Data rate to 2.4MB/Sec
- Average access times a fast as 15 milliseconds
- Breaks DOS 32MB limit

8000 Series 8 inch Winchester technologies intelligently interfaced to microcomputers

8000A Series

Mainframe: NMS Disk/Tape systems and controllers provide economical, compact, and high performance mass storage that can be *formatted as one volume*. When you need performance and/or storage on your PC, XT, AT and RT, you need the industry standard NMS 8000 series with Multifunction Controller. The SMD-SCSI single board controller you've been waiting for is available now... The NMS 8000A.

Tape Back-Up: NMS provides ANSI-IBM format ½ *inch tape systems* and 60mb of file-by-file/streamer ¼ inch cartridge tape systems. (NMS 9000 and PC .25 series).

Laser Optical: Complete, 12 inch media, 1000MB memory systems that support DOS applications and format as one volume.

Warranty: 12 months (RTV).

8100 Series

Selection: Only NMS provides selection of 8 inch *and* 5.25 inch technologies. Where speed, power and networking are important . . . NMS is there.

Tape Back-Up: An option you control . . . file by file and streamer backups. 60 megabytes per cartridge. Fast, reliable, and easy to use. *One half inch* ASCII/EBCDIC tape systems are available too.

DOS Limits: *They don't exist* with NMS memory systems. We were the first to break the barriers for you!

Call us today!

National Memory Systems CORPORATION

355 Earhart Way
Livermore, CA 94550

(415) 443-1669
TELEX 821892 NMSUD

► *DOS, XENIX, AIX Compatable*

► *Ask about our family of ESDI, SMD, and SCSI Controllers*

PRICES VALID THROUGH 5/01/87

— Published prices assume C.O.D. or C.I.A. —
— Compatible with all popular networks —
— One year RTV warranty —

Inquiry 203

Taking Control

Dick Pountain

The theme of this month's column is control. I've recently been playing with three different systems that allow a microcomputer to control events in the real world. What they have in common is their use of a high-level language to achieve this control. That's significant to me because I'm basically a software person. If the high-level language is also interactive, you can build applications by *rapid prototyping*, the industry's jargon for "try it and see."

These systems let a microcomputer control events in the real world

Scorpion

The first system is the Scorpion controller from Micro-Robotics Ltd. This is a standalone single-board computer to which you need add only a terminal to talk to it and any mass storage you may want. My "terminal" was a Macintosh running a simple VT100 emulation program and connected to the Scorpion's serial port. This port conforms to the S5/8 standard that employs TTL voltage levels; the IBM PC does not work with this standard, so Micro-Robotics also offers an adapter card to raise the port to full RS-232C compatibility.

The Scorpion is contained on a small card, measuring only 4 by 6 inches, on which a CMOS Hitachi HD6303 microprocessor is mounted. This 8-bit processor is a descendant of—and code-compatible with—the old 6800 and has become popular as a slave processor and for applications that require low power consumption. It is packaged in a tiny surface-mounted flat pack and looks quite lost among the other chips. In addition to the CPU, the Scorpion has sockets for a system ROM, a user ROM or EPROM, 24K bytes of RAM in three chips, a clock/calendar, and lots of interfaces. The whole system draws only 80 milliamperes, and you can easily power it with a 12-volt battery, although I used the optional adapter. The RAM is nonvolatile and is maintained by a rechargeable lithium cell fitted on the card. When the Scorpion is switched off, programs are retained in memory, and you can have them start automatically when you turn it back on, if you wish. The Scorpion also has a ROM socket from which you can auto-boot a program.

The card contains 21 assorted I/O connectors and 16 sets of servo output pins in addition to an edge connector that brings out the system bus—although it seems unlikely that you would want to expand the I/O capabilities much further. Three of the connectors are for a serial terminal, an optional LCD, and an optional 20-key keypad. The rest are all concerned with controlling various devices.

Eight analog-sense inputs read either voltage or frequency from external sensors; two shaft-encoder inputs receive feedback from the rotating drive shafts of motors; four digital outputs can drive 500-mA peak loads or 100-mA continuous loads; the servo outputs can drive Futaba servo motors that have automatic feedback position control; and you can configure a user port for pulse-counting TTL signals at up to 0.5 megahertz or for digitizing waveforms and generating frequencies. Finally, there is a network connector for the Philips I²C network, a new standard for connecting the application-specific peripheral chips used in video, teletext, and speech-synthesis systems. The network can handle 64 digital I/O lines, 32 analog inputs, 8 analog outputs, a color video display, a speech-synthesis ouput, and an infrared handset decoder.

This splendid array of I/O channels would be useless to me except for the high-level language that makes them extremely easy to use. The Scorpion language, devised by Micro-Robotics, is loosely based on BASIC or Logo, depending upon whom you talk to. It has a simple, clean syntax superior to either one and resembles a simplified Pascal. It's fully interactive like Logo: You can execute statements directly from the keyboard or define named procedures and functions. It's also a multitasking language—essential for control applications. For more details, see the text box "The Scorpion Language" on page 280.

You can include machine code in Scorpion's programs, for example, to handle interrupts, but performance considerations seldom require this. The Scorpion language is about as fast as interpreted BASIC on computation-intensive jobs; however, typical control programs are not computation-bound. They tend to be loops that read the various interfaces and spend much of their time waiting; the interfacing primitives are quite fast enough to read a device thousands of times a second. You may need a little practice to design multitasking programs in which the individual tasks are small enough and fast enough not to degrade each other's performance.

I received an assortment of gadgets to plug into the Scorpion, such as a thermocouple, an optical sensor, a one-line LCD, and a stepper motor. Combining these into simple systems was extremely easy with the Scorpion language. Micro-Robotics also offers more complex devices, such as a tiny vision system that plugs into the Scorpion's user port and can capture and process an image at a resolution of 128 by 256 pixels in 100 milliseconds; it uses a lens from the miniature Pentax 110 camera. The nicest thing of all about the Scorpion system, though, is the price: A basic Scorpion with power supply is £249; the vision system is an extra £130.

RTX Robot Arm

The second system is a serious robot arm

continued

Dick Pountain is a technical author and software consultant living in London, England. He can be contacted c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

QSP SUPER MICRO

286 AT™



- ZERO WAIT STATE
- 1 MB high speed (120NS) DRam on board
- 6/8 MHz (10 MHz opt.)
- Licensed Phoenix BIOS
- Built-in 2 serials & 1 parallel port
- Reset button & turbo mode LED
- Hold up to 5½ht drive
- Clock/calendar w/battery backup &
- rechargeable AA battery set mounted
- 200 Watt power supply
- Setup software
- Hard cover User's Manual

ALL FOLLOWING MODELS WITH AN IBM® COMPATIBLE ENHANCED KEYBOARD

CALL FOR BEST PRICES ON OUR ADD-ON CARDS

MODEL 1 $1,345.00

Above configuration +
- 1.2 MB floppy drive
- WD H/F disk controller

MODEL 2 $1,449.00

MODEL 1 +
- Hercules compatible monographic w/printer port
- Mono monitor

MODEL 3 $1,944.00

MODEL 1 +
- EGA card (16 colors, 640 x 350 Res.)
- EGA monitor

MODEL 4 $2,049.00

MODEL 2 +
- Seagate 30MB high speed hard disk (39MS)

TURBO XT™ $389.00

w/256K, 1FD + CTL, K.B., 150 WATT P.S.

Open Saturdays

QSP INC.

SALES: (408) 435-8222
Technical Support (415) 657-1410
780 Montague Expy., Ste. 207
San Jose, CA 95131

No surcharge for MasterCard or VISA; Fortune 1000 Purchase Order welcome. Dealer and Corporate inquiries welcome; IBM, Intel, Hayes and Hercules are registered trademarks of their respective companies; PC, AT, PC XT, PC AT are trademarks of IBM Corporation.

called RTX from Universal Machine Intelligence Ltd. A *serious* robot arm is one that's big enough to knock you down if it gets angry, as opposed to a toy for picking up matchboxes at parties. RTX stands 4 feet, 3 inches tall, and I wouldn't pick a fight with it. Although it's primarily aimed at educational users, it has sufficient power and precision for light industrial jobs.

RTX doesn't look like the typical industrial robot; it has a vertical *z* axis that makes it look rather like a photographic enlarger. The actual arm, which operates in the horizontal plane, slides up and down a vertical column, or linear slideway, to add the third dimension. The vertical motor, which does all the lifting against gravity, is installed in the base unit, so it can be bigger and more powerful (20 watts); it can lift 4 kilograms.

RTX has five movable joints controlled by seven motors. The arm has shoulder, elbow, wrist, and gripper joints—the wrist has two. The wrist unit is a box with its

continued

The Scorpion Language

When the Scorpion starts up, it asks if you want to clear memory. If you answer no, the system keeps the program currently in memory and may automatically run it. If you answer yes, you get an arrow prompt, and the system is ready to program. The Scorpion language, complete with a simple full-screen editor, resides in the system ROM; it uses TO, as in Logo, to define procedures, for example, TO greet PRINT "Hello world!" END. You invoke this procedure by typing its name, greet.

Procedures can contain parameters and local variables defined with LOCAL. Scorpion supports the control structures IF. . .ELSE, WHILE, REPEAT, and FOREVER and imposes block structure by using brackets. For example:

```
IF test > 200
[ WAIT 100 TURNOFF 2 WAIT 100
  TURNOFF 1 ]
ELSE [ TURNON 1 TURNON 2 ]
```

Many procedures can coexist in memory; you can selectively LIST them, or you can EDIT them with the built-in editor. There is no mass storage on the Scorpion card, so you save programs on your terminal's disks by typing LIST ALL and capturing the output via your communications package's ASCII file-transfer facility—like downloading from BIX.

The Scorpion supports 24-bit signed-integer arithmetic, Booleans, bit-wise logical operators, pointers, and pointer arithmetic. You can input hexadecimal numbers if you use the $ prefix. As in BASIC, you can use scalar variables without previously declaring them, and you use DIM to declare arrays. The Scorpion also supports tables of constants. These have an advantage over arrays: You can embed them in a procedure without first initializing them.

Multitasking is straightforward; to run a procedure as a task, you type START *procedurename*; to terminate a task, you type STOP. LIST TASKS tells you what tasks are running. (Task 1 is the system task, and it is always running.) You can even run tasks that haven't been defined as procedures. For example, START [FOREVER WAIT 1000 PRINT "Hello world!"] will generate "Hello world!" every second. START is a function that returns the task's identification number, so if you want to have tasks starting and stopping under program control, you could enter *tasknumber* := START [FOREVER WAIT 1000 PRINT "Hello world!"] and later STOP *tasknumber*. In addition to WAIT, which gives a pause measured in milliseconds, AWAIT pauses until a Boolean expression becomes true, for example, AWAIT *test* > 200.

The core of the Scorpion language, however, lies in the built-in keywords that access the various I/O channels. Each type of interface has its own dedicated keywords. The analog sensors are SENSE 1 through SENSE 8; the shaft encoders, SHAFT 1 and SHAFT 2. The servo ports are controlled by ANGLE, SETANGLE, and MOTOR. The digital outputs are switched on and off with TURNON and TURNOFF, respectively, and read or set by OUTPUT. A simple configuration composed of an infrared sensor connected to analog port 1 and a motor connected to servo port 3 could, for example, advance the motor whenever the sensor is illuminated:

```
FOREVER
IF SENSE 1 > 200
[ temp := ANGLE 1
  ANGLE 1 := temp + 10 ]
```

The real beauty of an interactive language like this one is that you can always find out instantly, from the keyboard, what is happening to the devices. For example, typing PRINT SENSE 1 gives you the value at the sensor input.

TimeWand™ - Gathering Information



Bar Codes, Computing, and the TimeWand... a Closer Look.

"A successful business runs on accurate, timely information." An obvious statement perhaps, but one that every personal computer user must keep in mind. In order to get the reports we require, we must ensure that the information on which we base our decisions is as up-to-date as possible. This is where a bar code reading system such as the TimeWand can be used to improve efficiency in the office or workshop. The TimeWand provides a convenient way to ensure that your computer has all the facts, all the time.

Let's use inventory control as an example. Once an inventory system is set up on the computer, you are faced with the important task of keeping the inventory up to date. The TimeWand gives you a quick and efficient method of getting information into your computer system. To enter an item into inventory (such as the copper elbows shown above), all you need to do is scan the item, the quantity, and transfer the data to your computer. By using TimeWand, you bypass the time-consuming steps of writing down every transaction, deciphering hand-written notes, typing in each inventory transaction by hand, and searching for transcription errors that might have occurred. The TimeWand is an ideal tool for gathering information for use in your business.

From time-billing to tracking work orders to monitoring security, the TimeWand provides an inexpensive solution for your data collection needs. Call or write Videx today for more information about how the TimeWand can help in your business.

TimeWand (2K version) **- $198**
Recharger - $149
TimeWand Communication Software (IBM) **- $299**

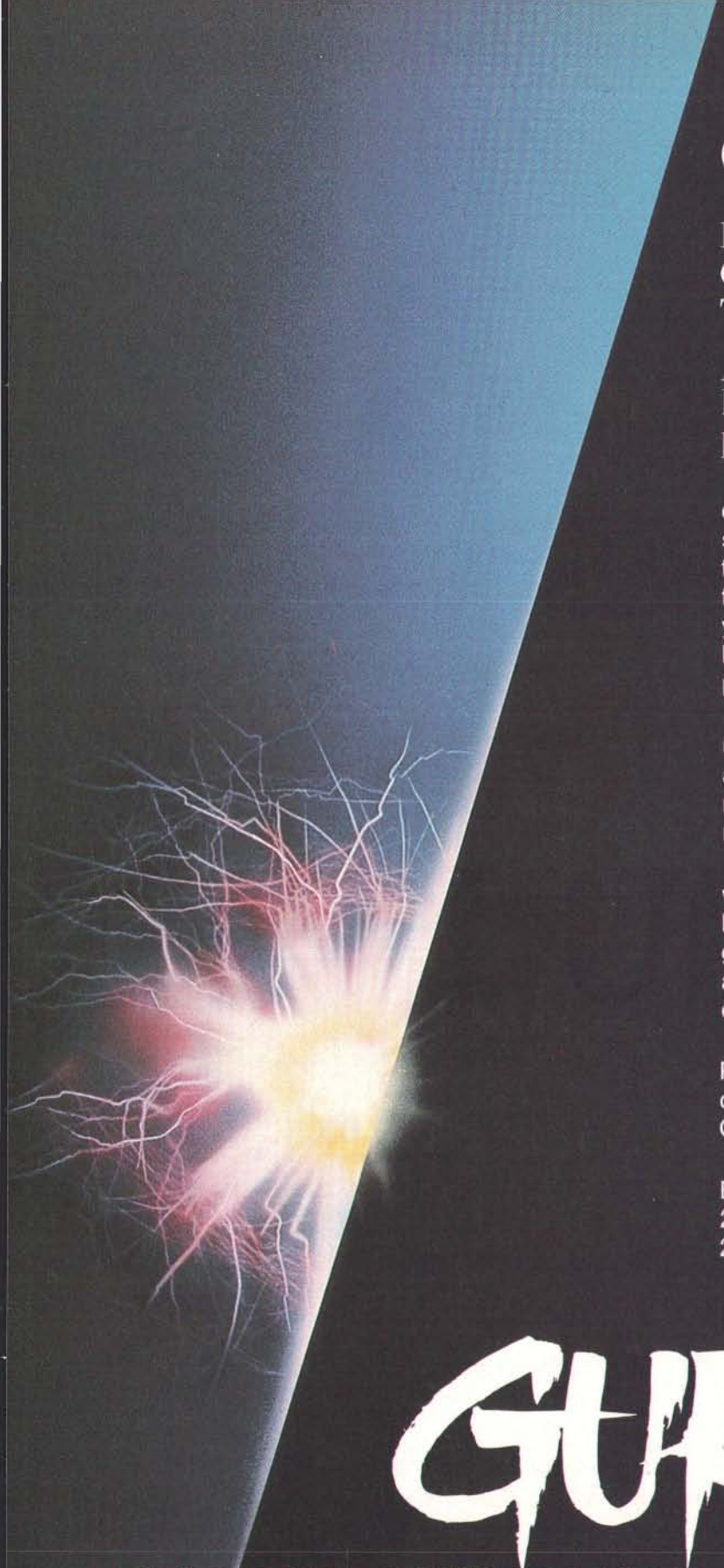
Software available for the Macintosh, Apple // family, and Tandy (Model 100 and 200).

Videx®

1105 N.E. Circle Blvd., Corvallis, OR 97330-4285
503-758-0521
See us at ID Expo March 25 thru 27th
Long Beach Convention Center

Videx is a registered trademark and TimeWand is a trademark of Videx, Inc.

Inquiry 324



THE GREAT ESCAPE!

FROM IVORY TOWERS AND COLD COMPUTER ROOMS TO THE WARMTH OF YOUR OFFICE.

Artificial intelligence for business has arrived in a revolutionary new product . . . Guru.

At last, artificial intelligence designed especially for business! Guru brings together expert system capabilities of artificial intelligence, the productivity of familiar business computing tools and the ease of communicating with your computer using menus, commands or plain English. All available in a single, integrated program.

Guru works like human experts, considering uncertainties, reasoning through forward and backward chaining, asking for more information when needed, and explaining its recommendations.

Guru's expert system works hand-in-hand with all the familiar business computing tools like spreadsheets, statistical analysis, business graphics and a programming language, always available for both expert consultation and your everyday business computing needs.

Best of all, you won't need to learn LISP or PROLOG or buy fancy computers . . . Guru runs on your PC and communicates in plain English! Guru is artificial intelligence that means business.

For more information, call or write Micro Data Base Systems, Inc./Marketing & Sales, P.O. Box 248, Lafayette, IN, 47902, 317/463-2581, Telex 209147 ISE UR.

GURU™

ARTIFICIAL INTELLIGENCE THAT MEANS BUSINESS.

mdbs is a registered trademark and Guru is a trademark of Micro Data Base Systems, Inc., P.O. Box 248, Lafayette, IN, 47902

mdbs

own three degrees of freedom: The whole box can swivel horizontally in "yaw," and the gripper unit that emerges from it can "pitch" through a vertical quadrant and "roll" about its own axis. This allows complex motions and enables the simple pincer-type gripper to approach most points in its space from any direction. RTX doesn't have any sophisticated senses (e.g., sight), but each motor has feedback control via shaft encoders so that it is aware of its own position. For example, the gripper's feedback control stops it from closing further when it has applied a chosen force. The motors drive the joints through toothed belts and precision reduction gears, and the whole robot arm is solidly constructed from stout alloy castings and vacuum-formed plastics.

RTX is controlled from an IBM PC via an RS-232C connection. The robot itself contains intelligence in the shape of twin Intel 8031 microcontrollers that each have 128 bytes of on-chip RAM and 256 bytes of RAM for external workspace. Each 8031 is capable of controlling five motors, leaving some spare capacity for custom applications. The low-level driver programs for the 8031s reside in ROM and were written in a mixture of assembly language and PL/M. They operate asynchronously as slaves to the IBM PC's 8088, which communicates with them by message passing using a 3-byte message format over the serial link.

The driver program that runs on the IBM PC was written in Turbo Pascal, the few time-critical routines being compiled either as INLINE code or EXTERNAL procedures. The driver becomes memory-resident when it's loaded with the START command. You can control RTX in three main ways: by writing relatively permanent programs in Turbo Pascal using a supplied library of procedures; by manually leading the robot through a sequence of moves (via the LEARN mode in an interactive FORTH system) and then compiling them into a FORTH word; or by controlling RTX manually from the IBM keyboard using either FORTH or a program called Test.

Test is invoked from the DOS prompt and is a menu-driven program that lets you set up numerous parameters, such as motor speeds and accelerations, and the maximum force and error limits for each joint. It also permits soak testing of each motor, absolute numeric control of the joints, and initialization to the start position, which is frequently necessary during your first programming attempts after you've messed up the arm positions.

Programming RTX was an education for me. I had never really thought much about just how complex articulated mo-

continued

Inquiry 323



Copying diskettes will never be easier than pushing one button.

While your computer is busy doing other things, your Victory Duplicator can be making as many as eight copies of a diskette at once —producing up to 400 copies in an hour. DualMaster™ models can even make multiple copies of two different diskettes simultaneously. Just insert the diskettes and press one button.

Copy different formats, flawlessly.
An automatic format analysis program makes it possible for the Victory Duplicator to copy virtually any 5¼, 3½ or 8-inch diskette. The system tests for quality and accuracy at every stage of the process.

It practically services itself.
Each drive has a separate controller to maximize uptime. Simple diagnostics to verify drive alignment and industry standard drives allow you to maintain your system without waiting for outside service.

All at an attractive price.
Victory Duplicators offer fast copying, serialization, copy protection, a communications port, a four-month warranty and much more— all for one low price.

Call 1-800-421-0103.
Call today for more information. (In Texas, call 512-450-0801.)

VICTORY ENTERPRISES
Technology, Inc.

8910 Research Blvd., Suite B2
Austin, Texas 78758



The Real World Runs on Real Time.

*M*odern intelligent systems require real time response and high efficiency. That's why OS-9/68000 has been the designer's choice in thousands of the most demanding real-life applications.

OS-9 is very compact, highly adaptable, and fully ROMable. It's C source code compatible with Unix, and it's supported by a wide range of outstanding software tools, including graphics and networking options.

Many leading suppliers of 68000 and 68020 based systems offer ready-to-run OS-9 packages for their products. Or you can use a Microware PortPak to install OS-9 on your own custom hardware.

When microseconds count, you can count on OS-9.

OS-9/68000™— The Emerging Standard.

microware®

Microware Systems Corporation
1866 N.W. 114th Street • Des Moines, Iowa 50322
Phone 515-224-1929 • Telex 910-520-2535

OUR PLUG-IN CARDS GIVE YOU PLUG-IN CONTROL.

Your IBM PC/XT/AT or compatible can control any IEEE-488 instrument.



You can:

- ☐ Plug-in to BASIC, C, FORTRAN, or Pascal.
- ☐ Use HP-IB plotters, printers, and instruments.
- ☐ Spend less time programming.
- ☐ Call (617) 273-1818 and put us to the test.

Complete hardware and software solutions for just $395.

cec Capital Equipment Corp.
99 South Bedford Street
Burlington, MA. 01803



C++

Introducing The Most Important Programming Development Since The Introduction Of C...

ADVANTAGE C++ For MS/PC-DOS, Exclusively From LIFEBOAT.

They say you can't be all things to all people. But Lifeboat's **ADVANTAGE C++** proves that you can be! This exciting new product, developed by AT&T, represents a major programming breakthrough.

ADVANTAGE C++

- Opens the door to object-oriented programming.
- Allows programs with greater resilience, fewer bugs.
- Lets you write reliable, reusable code that is easier to understand.
- Includes many enhancements to C, yet maintains full compatibility with existing C programs.
- Is the key to developing large and sophisticated programs more productively.
- Has all the benefits of C, without its limitations.

ADVANTAGE C++ is now available for the most popular C compilers, Lattice C and Microsoft C.

Why be limited to just C ... when you can have all these pluses! To order or obtain a complete technical specification sheet call: **1-800-847-7078**

In NY: 914-332-1875.

55 South Broadway Tarrytown N.Y. 10591

LIFEBOAT

The Full-Service Source for Programming Software.

tion is, and the experience has given me a new respect both for robot system programmers and for the human brain, which handles it all the time unconsciously. One thing I learned is that controlling a robot is an inherently concurrent exercise; although you could in principle program a complex movement as a strict sequence of different joint movements, the result would be awkward and slow. In practice, you need all the joints to be moving at the same time, which brings in considerations of synchronization and communication. On RTX, the driver software can handle this for you.

Other complications arise as well. Suppose you want the gripper to follow a smoothly curved path. You might approximate the path with a lot of tiny linear moves, but this would be tedious and slow as the arm would stop before each move. If you tell RTX to move the arm to a new position, the software will drive it there by the most efficient route it can find. RTX software also has an "interpolation" mode in which you create a series of seven element arrays of distance increments (one for each motor) that describe the curve; the arm then smoothly follows the curve.

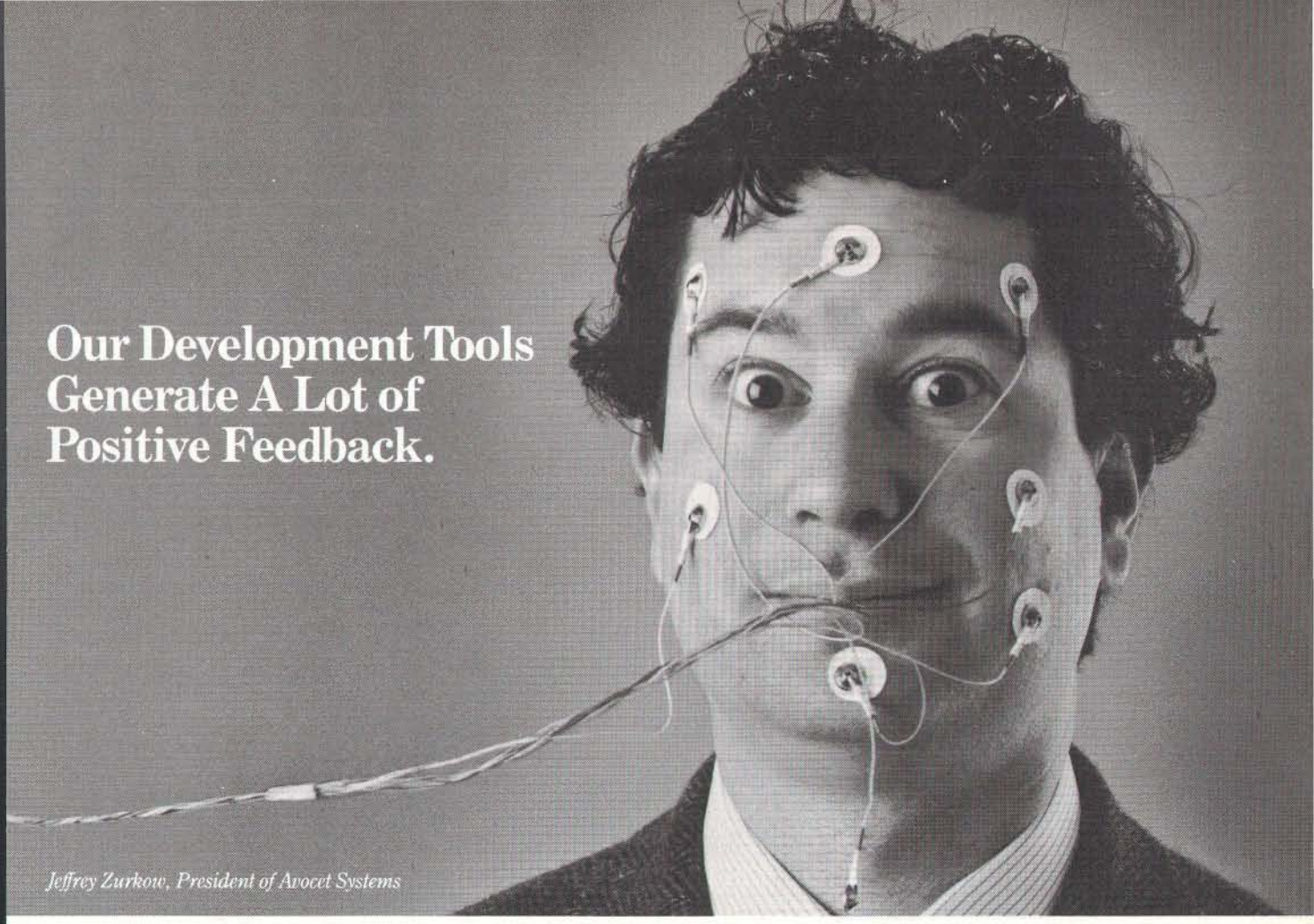
The Turbo Pascal library contains 14 procedures that can be used to control the arm. They are implemented via a software interrupt so that you can in fact use them from C or other languages by putting the command code in AX, putting a pointer to an eight-word table of parameters in BX, and calling the interrupt.

I did most of my RTX programming from FRTX, the FORTH system. This is a multitasking FORTH-83 system with a special teach-and-replay vocabulary added. To teach RTX a new movement, you can type LEARN NEWMOVE and then start to manually make the required movements using the cursor and function keys to control each axis. When you press the End key to finish, the sequence of moves is compiled into the dictionary as a FORTH word called NEWMOVE, which you can execute by typing its name or use in the definition of other words. You can compile the current location of the arm as a constant, using PLACE *name*, so that you can refer to this location by name. RTX worked well, as long as I entered the moves slowly and deliberately. The cursor keys start an arm movement and the space bar stops it; it's hard to avoid instinctively holding down the cursor key and causing an overshoot.

As with the Scorpion, the interactive nature of FORTH makes programming RTX a cinch. If something happens that you don't understand, it takes just seconds to write a test word to read a port or inspect a memory location so you can see

continued

Our Development Tools Generate A Lot of Positive Feedback.



Jeffrey Zurkow, President of Avocet Systems



Avocet offers an entire line of low-cost microprocessor development tools.

Target Microprocessor Families Supported

1802/1805	68000/68010	COP400
6502/65C02	68020	HD64180
6801/6301	8048/8041	NEC 7500
6804	8051	TMS-32010
6805/6305	8085	TMS-32020
6809	8096	Z8
68HC11	F8/3870	Z80

Host Operating Systems

CP/M DOS VAX Unix VAX VMS

AVMAC Macro Assemblers ..... from $349

AVSIM Simulator/ Debuggers ..... from $299

Other Development tools ..... Call for full catalog

Microprocessor development tools without the shock of a big price tag.

The AVMAC family of assemblers from Avocet lets you develop microprocessor code on your personal computer or VAX. Avocet has been developing PC software since before there *were* PC's. Our products have been refined over several generations giving you powerful and flexible development tools. They work with your existing operating system and text editor, so they're easy to install and easy to use.

Do all of your development on a single PC or VAX without switching systems.

If your next project calls for a different microprocessor, just call Avocet. There are Avocet assemblers for most common microprocessor families. So modifying your development system is as easy as changing diskettes. Check the chart—the assembler you need is probably there.

With Avocet, you're wired into a family of support products you can trust.

Each assembler package includes the AVLINK linker, AVLIB librarian, AVREF cross-reference generator and other utilities. And Avocet also offers you a host of other tools you need, such as TRICE self-powered in-circuit emulators. AVPROM programmers, text editors and the AVSIM full-screen simulator/debugger. So the PC on your desk can hold a workbench full of development tools.

Try before you buy. And we'll ship in 48 hours or less.

You probably need your tools right away. And that's when you'll get them. When you order from Avocet, we'll also send you a complete demonstration kit for both our assembler and our AVSIM simulator/debugger.

Try the demo for thirty days—if you aren't completely satisfied, we'll refund your purchase price, less $35.00 for the demo disk. That's yours to keep, which is a good deal by itself! We're sure you'll find Avocet the best connection you've ever made.

Call **1-800-448-8500.**

Avocet Systems Inc., 120 Union St.
P.O. Box 490, Rockport, ME 04856 Inquiry 34

AVOCET
SYSTEMS, INC.

Inquiry 189

Maximum Memory at the Lowest Price

INTRODUCTORY OFFER—Prices Good Until March 15, 1987



FULLY POPULATED! 4MB at 256KB Prices

The King's Bishop™ $595

- **4 Megabytes** of dynamic RAM for your AT, XT-286, or compatibles—**FULLY POPULATED!**
- Runs at 6 MHz with Zero Wait-state; 8, 10, 12 and 16 MHz with One Wait-state
- Accesses 16-bit words
- Completes conventional memory (backfills) to 640K
- Fully supports Extended and Expanded (LIM/EMS) operation
- Ram Diagnostics and Print Spooler software included
- Two-year Limited Warranty for registered users
- **8 MHz Zero Wait-state version—$695**
  10 MHz Zero Wait-state version—Call for Price



The Queen's Castle™. . . . $295

- **2 Megabytes** of dynamic RAM for your PC/XT or compatible—**FULLY POPULATED!**
- Runs at 4.77 and 8 MHz
- Completes conventional memory (backfills) to 640K
- EMS Software for expanded (LIM/EMS) memory operation, RAM Disk, RAM Diagnostics, and Print Spooler
- Two-year Limited Warranty for registered users



Dealer and O.E.M. Inquiries Invited

MICRON TECHNOLOGY, INC.

Systems Group
2805 East Columbia Road
Boise, Idaho 83706

We're building our reputation on innovation.

IBM PC/XT/AT are trademarks of IBM Corporation

For Orders and Information:

1-800-642-7661

For Technical Service and in Idaho: (208) 386-3800

what's going on. RTX costs £5000, which is cheap for a robot of this capability. The people at Universal Machine Intelligence tell me they already have orders from customers in light industry, including one who is using RTX to manipulate cloth under sewing machines.

Martello

The third control system is a FORTH development system called Martello from British Telecom, the U.K.'s equivalent of AT&T and one of our largest corporations. British Telecom made a small foray into microcomputing about a year ago with a range of business desktop computers that were "badge-engineered" from Rair and ICL. Martello is a product from British Telecom Research Laboratories, a different division of the huge company, and it's intended for scientists and engineers interested in instrumentation and control. The significance for me, as a FORTH enthusiast, is that it represents another big step in the acceptance of FORTH. Another large U.K. utility, British Rail, is presently evaluating FORTH as a possible replacement for assembly language programming in its critical train safety systems. Despite its lack of academic "respectability," FORTH seems to be increasingly accepted by those who have to get things done.

Martello is based on the relatively new STE bus (also known as the IEEE P1000). The basic system contains a 19-inch rack with 16 slots for single Eurocards, a CPU card, a disk controller, and twin 800K-byte 3½-inch floppy disk drives that occupy two slots. A 55-W switching power supply is hidden in the shallow base of the unit. It is a conventional FORTH system from the hardware point of view, relying on conventional microprocessors rather than on dedicated FORTH engines like the Novix chip. The system I tested had an 8-bit 8085 CPU; Motorola 68000 and Hitachi 64180 CPU cards should be available soon. Other available boards include a color graphics subsystem using an NEC 7220 graphics processor. You can include more than one CPU board for multiprocessing systems, and STE permits multiple bus masters. The 8085 card can address up to 1 megabyte of bus memory, 128K bytes of which can be local.

My chief interest in Martello was the software, Martelforth, which contains a FORTH-83 standard kernel in ROM plus some significant enhancements. It was partly developed by Microprocessor Engineering Ltd., a veteran firm on the U.K. FORTH circuit. The most obvious enhancement is that Martelforth includes a "proper" disk filing system rather than the orthodox single-blocks file; FORTH source programs are kept in named files that are organized into a hierarchical directory system, as in PC-DOS or UNIX. For serious applications I find such a filing system essential, and I can't understand the FORTH purists' resistance to it. Code inside the files is still organized into numbered blocks, so you can easily port code from conventional systems. The built-in full-screen editor is extremely powerful, featuring search and replace, on-line help, and full-block, rather than the usual single-line, moves.

Other tools and utilities supplied on disk include an interactive debugging and tracing environment that "animates" the source code as it executes in single-step fashion, while showing the contents of stacks and other vital system parameters. A floating-point package, ROM-code generator, EPROM programmer, and an 8085 macro assembler are standard with Martelforth. Its ROM includes an interrupt handler, and multitasking uses interrupts rather than the simpler but less powerful round-robin scheduling normally used in FORTH. Thus, you can synchronize tasks to external events in real time. Finally, there is a professional-quality floppy disk test program that can exhaustively test the physical performance and integrity of both drives and disks.

All in all, Martello is a good example of what a modern interactive development system can look like and would, I'm sure, come as a pleasant surprise to anyone who thinks that machine code and swearing are the only way to develop control systems. The Martello system I tested costs £1975, including the license for the software.

Don't Be Scared

Control systems have always frightened me. They smell of solder, oscilloscopes, and assembly language programming, but using a high-level language takes a lot of the fear out of them. More important, it also saves development time. ■

Companies Mentioned

British Telecom Research Laboratories
Martlesham Heath
Ipswich, Suffolk
IP5 7RE, U.K.
(0473)-642933

Micro-Robotics Ltd.
264 Newmarket Rd.
Cambridge CB5 8JR, U.K.
(0223)-323100

Universal Machine Intelligence Ltd.
The Royal Victoria Patriotic Building
Trinity Rd.
London SW18 3SX, U.K.
(01)-871-1339

We used to be PC 1
We're still your #1 Choice !

5830 E. Washington Blvd.,
City of Commerce, CA 90040

Technoland™

5 Days Guaranteed Shipping
Next Day Delivery Available
Free UPS (G) Shipping
30 Days Money-back Satisfaction Guarantee
California Residents —
We'll Pay Your Sales Tax !

YOUR #1 CHOICE

Technoland PC/XT™
$595



Includes 8088-2 Dual Speed (4.7MHZ-7.4MHZ) unit, 640K RAM, 360K Floppy Drive W/Controller, AT™ Style Keyboard, 135W Power Supply, **MS-DOS 3.1 W/Manual,** System Manuals, **Full 18 Months Warranty,** Run all major software for IBM-PC™ and PC/XT™.

Technoland AT™
$1,159



Includes 80286-Based 8MHZ unit, AMI BIOS, 512K on 1MB Monther Board, 1.2 MB Floppy Drive, W.D. Hard/Floppy Controller, Clock/Calendar W/Battery Back Up, AT Style Keyboard, 200-W Power Supply, **MS DOS3.1 W/Manual,** System Manuals, **Full 18 Months Warranty,** Run all major software for IBM-PC/AT™

Monochrome System
Basic System Plus . . .
- Monochrome Graphics Adapter
- 12"TTL Monochrome Monitor

XT™ $ 795
AT™ $1,359

Color System
Basic System Plus . . .
- Color Graphics Adapter
- 13" RGB Color Monitor (640 x 200)

XT™ $ 995
AT™ $1,559

EGA System
Basic System Plus . . .
- Enhanced Graphics Adapter
- 13" High-Res RGB Color Monitor (640 x 350)

XT™ $1,275
AT™ $1,839

Seagate Hard Disk



Hard Disk Kit **$389**
- 20 MB Half Ht. ST225
- Western Digital Controller
- Boots From Hard Disk
- 65 MS Access Time

20 MB 4026 **$549**
30 MB 4038 **$629**
40 MB 4051 **$759**
- 39 MS Access Time
- Linear Voice Coil Activator
- Boots From Hard Disk
- Auto Head Parking

Fully DOS compatible Each system comes complete with Ready-to-Install Hard Disk, Cables, Controller, Manual, Software, and Mounting Hardware. Add $150 for External Case.

"IBM's Brother" Monochrome Monitor
- IBM Lookalike
- 12" Screen
- Amber or Green

$119



High Resolution RGB Color Monitor
- 13" Screen
- 640 x 200 Resolution
- RGB — 16 Colors

$339



EGA Compatible Color Monitor
- 31" mm Dot Pitch
- 13" Screen
- 640 x 350 Resolution
- RGB — 16 Colors

$449



AT™ Multifunction Card $169
- Expandable to 3 MB (OK)
- Parallel, Serial and Game Ports

XT™ Multifunction Card $105
- Clock/Calendar, FDC
- Parallel, Serial and Game Ports
- RAM Disk & Printer Spooler (Software)

Mini I/O Card $ 89
- Parallel, Serial and Game Ports

Mono-Graphics Adapter $ 99
Color Graphics Adapter $ 89
EGA Card-Short Card $259
- EGA, CGA, MDA & Hercules Compatible

Tiny Turbo Card $449
- High-Speed Accelerator for PC and PC/XT™
- Replaces 8088 with 80286
- Socket for 80287 on Board
- Short Card

New!

High Speed 250 Printer $479



554x380x178 (LxDxH) 33 lbs Weight

- **Clear Printing at 250 cps.**
- Double-Size and Double Strike Printing
- 136 Columns
- 9x9 dot Composition
- Underlining Capability
- **Professional Office Equipment**

Citizen Printer
MSP-20 (80 Column) $329
MSP-25 (136 Column) $489
- 200 cps Draft/50 cps NLQ
- IBM, Epson Compatible
- Parallel Interface

Floppy Disk Drive $ 90
- Half-Height
- DS/DD-360K
- Name Brands-TEAC, Panasonic, Mitsubishi.

1.2 MB Floppy Disk Drive $125
Hard Disk Card-20MB $408
- 3½ Hard Card
- Boots from Hard Disk
- IBM XT™ Compatible

Hayes Compatible Modem $139
- 300 & 1200 BPS
- Short Card
- Fully Hayes Compatible

Enhanced Keyboard (5339) $ 79
- Separate Cursor & Numeric Pads
- Keys in Standard Locations
- LED Status Indicators
- 12 Function Keys

135W Power Supply $ 79
200W Power Supply $119

Technoland's Policy:

We accept Master Card and VISA (no surcharge), money order, chashier's check, personal check (please allow 10 days to clear), company / institutional PO's and wire transfers. We pay shipping (UPS ground — faster shipping available at additional charge) in continental US. We pay applicable sales tax.

Any item bought from Technoland (including software if unopened) may be returned for a full refund within 30 days of the date it was shipped if for any reason you are not 100% satisfied. All Technoland products carry Technoland's one year limited warranty; some products also carry manufacturer's warranty. Selected Technoland products may carry additional warranties. Warranty policy requires that you submit proof of purchase and obtain an RMA number from us by telephone.

IBM, Hercules, Compaq, ATT, Panasonic, TEAC, Mitsubishi, ARC, Sanyo, Western Digital and Seagate are trademarks of their respective companies. MS-DOS is a trademark of Microsoft Corporation. IBM PC, IBM XT and IBM AT are trademarks of IBM Corporation.

Quantity Discount Available !

Order Toll Free :
(800) 222-3978

In California : (213) 724-2781
Technical Support : (213) 724-1684
Customer Service : (213) 724-1685
Mon. — Sat. 8:00 a.m. to 5:00 p.m.

As your introduction to

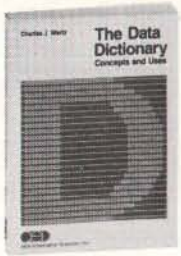
The Library of Computer and Information Sciences

Take any 3 books

(Publishers' prices shown.)



42100 $29.95



41612 $29.50
(Softbound)



32259-2 $35.00
(Counts as 2 choices)



70106-2 $42.95
(Counts as 2 choices)

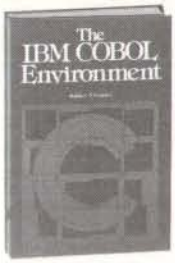
DATABASE



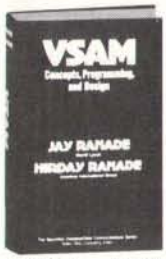
66400 $28.95



37990 $19.95
(Softbound)

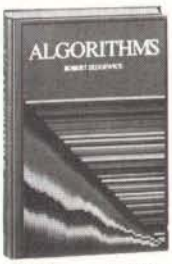


54447-2 $33.95

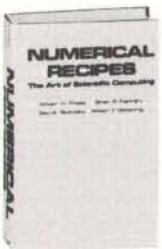


85950-2 $34.95
(Counts as 2 choices)

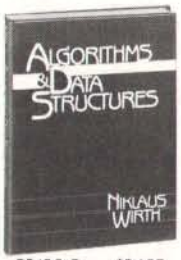
IBM ENVIRONMENT



32486 $28.95



64900-2 $39.50
(Counts as 2 choices)



32490-2 $34.95
(Counts as 2 choices)



79164 $29.95

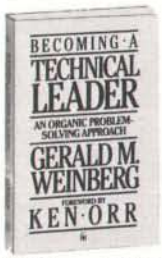


40107 $22.50

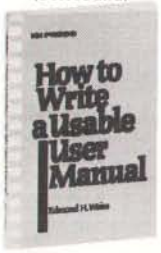
COMPUTER SCIENCE



77620 $25.00
(Softbound)



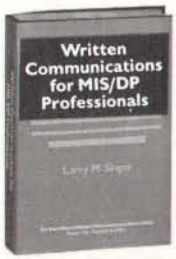
35700 $28.50
(Softbound)



53920 $14.95
(Softbound)

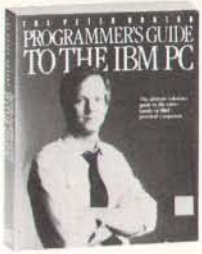


69930 $28.00
(Softbound)

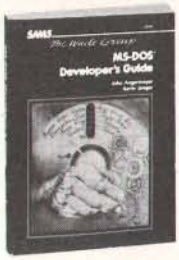


88018 $22.95

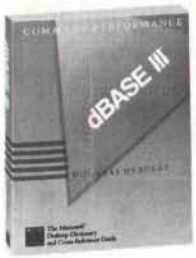
PROFESSIONAL TOOLS



68430 $19.95
(Softbound)



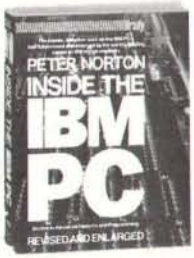
63250 $24.95
(Softbound)



39640 $22.95
(Softbound)



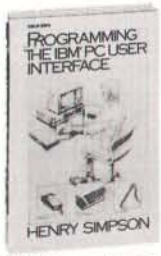
32284 $18.95
(Softbound)



55520 $19.95
(Softbound)

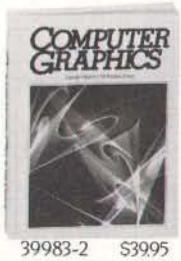


55506 $21.95
(Softbound)



70735 $18.95
(Softbound)

MICROS



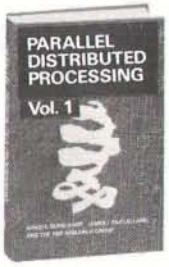
39983-2 $39.95
(Counts as 2 choices)

GRAPHICS

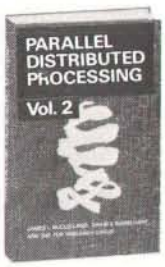
for only $1.00 each

values to $89.85

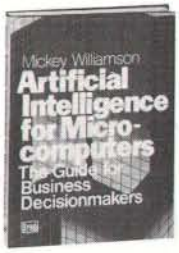
You simply agree to buy 3 more books —at handsome discounts—within the next 12 months.



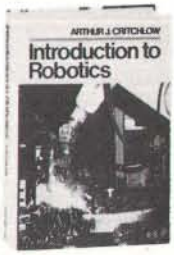
67116 $27.50



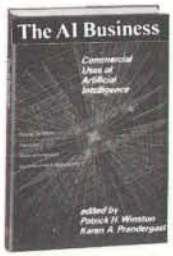
67109 $27.50



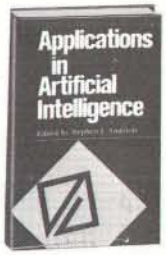
34462 $24.95



56283-2 $35.95
(Counts as 2 choices)

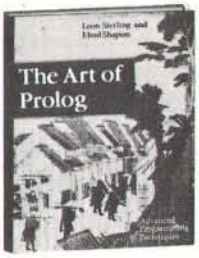


32439 $15.95

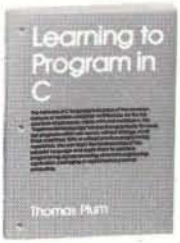


34137-2 $49.95
(Counts as 2 choices)

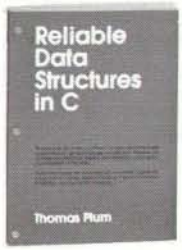
AI AND ROBOTICS



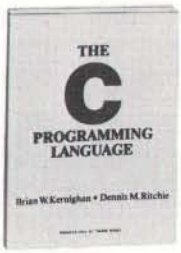
34422 $29.95



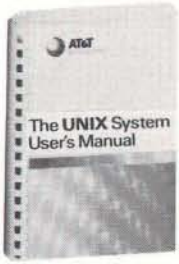
58088 $25.00
(Softbound)



73870 $25.00
(Softbound)



37206 $24.95
(Softbound)

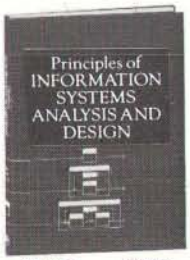


85379 $29.95
(Combbound)

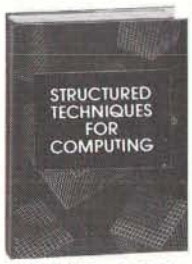


35573 $24.95
(Softbound)

PROGRAMMING

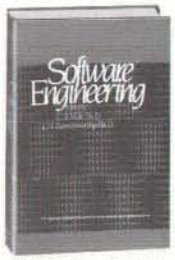


70119-2 $37.50
(Counts as 2 choices)



80450-2 $49.95
(Counts as 2 choices)

SYSTEMS DESIGN

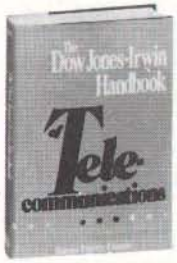


52340-2 $64.95
(Counts as 2 choices)

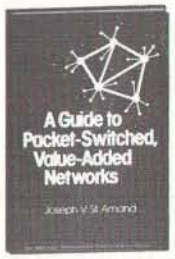


69940-2 $34.50
(Counts as 2 choices)

SOFTWARE DEVELOPMENT



42535-2 $60.00
(Counts as 2 choices)



51917 $19.95

COMMUNICATIONS

4 Good Reasons to Join

1. The Finest Books. Of the hundreds of books submitted to us each year, only the very finest are selected and offered. Moreover, our books are always of equal quality to publishers' editions, *never* economy editions.
2. Big Savings. In addition to getting 3 books for only $1.00 each when you join, you keep saving substantially, up to 30% and occasionally even more. (For example, your total savings as a trial member—including this introductory offer—can easily be over 50%. That's like getting every other book free!)
3. Bonus Books. Also, you will immediately become eligible to participate in our Bonus Book Plan, with savings of up to 65% off the publishers' prices.
4. Convenient Service. At 3–4 week intervals (16 times per year), you will receive the Library of Computer and Information Sciences News, describing the Main Selection and Alternate Selections, together with a dated reply card. If you want the Main Selection, do nothing, and it will be sent to you automatically. If you prefer another selection, or no book at all, simply indicate your choice on the card and return it by the date specified. You will have at least 10 days to decide. If, because of late mail delivery of the News, you should receive a book you do not want, we guarantee return postage.

If the reply card has been removed, please write to **The Library of Computer and Information Sciences, Dept. 7-EC7, Riverside, N.J. 08075** to obtain membership information and an application. Byte 3/87

Wyse takes the high cost out of high resolution.



At $999, the WY-700 Graphics Subsystem is easily affordable. And its 1280 x 800 resolution makes the best of software packages like these:

DESKTOP PUBLISHING
Ventura Publisher
PageMaker/PC
Frontpage
DeskSet
Pagemaster
Rim System
Compound Document Processor
Display Ad Make-up System
AdvanTex

GENERAL PC SOFTWARE
Lotus 1-2-3
Symphony
PC-Paintbrush

COMPUTER-AIDED DESIGN
AutoCAD
Cadvance
In-A-Vision
Generic CADD
VersaCAD ADVANCED
Workview
Procad PC
P-CAD Systems

GRAPHIC SYSTEM TOOLS
MS-Windows
GEM
MetaWindows
HALO
KEE PC

Wyse raises the standards for high resolution graphics, while lowering the cost.

Now you can have high resolution and full IBM software compatibility.

So Desktop Publishing applications can get the screen treatment they deserve. You can run spreadsheets like Lotus 1-2-3 with four times more data displayed on the screen. Computer-Aided Design packages can deliver their full potential. And Graphics-based pc environments finally have the high resolution they were made for.

You can do it all on the WY-700. A complete system, monitor and board, for just $999. With a large 15-inch display, full tilt and swivel, and a crisp 1280 x 800 pixel resolution.

The WY-700. It's your best solution for high resolution.

Write Wyse Technology, Attention: Marcom Dept. 700, 3571 N. First Street, San Jose, CA 95134. Or call toll-free, today, for more information.

Call 1-800-GET-WYSE

WYSE

YOU NEVER REGRET A WYSE DECISION.



WYSE is a registered trademark of Wyse Technology. WY-700 and the "V" shaped design are trademarks of Wyse Technology. © 1986 Wyse Technology.

Inquiry 337

Amiga Developers Conference

Bruce Webster

Bruce learns more about the Amiga and products to be used with it

Commodore put on another Developers Conference, some 18 months after its first one. Like the first one, it was held at the Doubletree Hotel in Monterey, California. Unlike the first one, it was not a resounding success. Much of the information presented was recycled from the first conference; many of the handouts were the same and were even dated May 1985. A lot of developers were unhappy with the conference itself, feeling they had spent a lot of money and had not learned anything new. Many expressed unhappiness with Commodore's struggles in marketing the Amiga. One developer (while at the conference) drafted a letter to Commodore reminding the folks there that the developers' survival was closely tied to the success of the Amiga and asking if Commodore could please do a better job of selling the thing. Forty-two of the developers attending signed the letter.

The Commodore representatives, to their credit, were for the most part honest about past mistakes and current problems, a candor that most found reassuring. Also reassuring was confirmation of a second straight quarterly profit (with hints of strong profits in the third quarter) as well as a steady climb in Amiga sales. Most interesting were the sales figures released. They're probably covered by the nondisclosure agreement I signed, so I won't repeat them here. However, if they are accurate, they would indicate that Amiga dealers are selling far more systems per store than Macintosh dealers sold during its first year.

Did Commodore announce any new machines, new hardware, new software, and so on? Sorry, no comment.

I almost didn't go to the conference dinner Friday night, but I'm awfully glad I did. The food was better than most mass banquets, the company was great, the awards presentation didn't drag on, but best of all were the videos. Yes, there were videos, just as there were at the Apple IIGS Developers Conference. However, these videos weren't slick, weren't professional, and weren't aimed at making you run out and be baptized by John Sculley. They were done by the crazies at the Amiga development group in Los Gatos, had no rock songs or heart-warming images, and were aimed mostly at having a good time. Several "commercials" poked fun at Commodore ("The Amiga 999! Totally incompatible with any previous product!"), the Amiga folks (RJ Mical and Dale Luck doing their Bartles-and-Jaymes imitation), and even Apple (Terry Ishida doing a wickedly good imitation of the Pathological Liar as an Apple spokesman).

The best videos, though, were two done by Allan Hastings. One was a space-combat video, along the lines of *The Last Starfighter*. The other had a "worlds within worlds" theme, taking you through the screen of a computer sitting on a table inside a house, through space to a planet, down to the surface, cross-country to a house, completely around the outside of the house, then through a window to a room where a computer sat on a table. Both of these were done with frame-by-frame computer animation on an Amiga, Allan using an 8mm video camera with single-frame advance to photograph each image after it was processed. The result was truly amazing. Allan hopes to show the films at the next SIGGRAPH conference, and I think many of the attendees—used to equipment costing tens or hundreds of thousands of dollars—are going to be surprised at what can be done with equipment totaling less than $3000.

As a developer, I would have probably decided that the conference was not worth my time and money. As a reviewer of Amiga hardware and software, I found it very worthwhile, especially since there was a minishow on the last day with different companies exhibiting their wares. It gave me a chance to see some products that were just being released or still under development, and it let me line up a number of products for review. Speaking of which . . .

StarBoard II

One of the firms represented at the conference was MicroBotics, maker of the MAS-20 hard disk that I discussed in my December 1986 column. MicroBotics has released its next product: StarBoard II, a memory-expansion box for the Amiga. Redmond Simonsen (yes, wargamers, *that* Redmond Simonsen) is the marketing director at MicroBotics, and he was kind enough to let me take a StarBoard II home.

The StarBoard II is slightly longer and about twice as wide (1.5 inches versus 0.75 inch) as the Alegra memory unit. Like the Alegra, it attaches to the expansion bus on the right side of the Amiga with two screws. As with the Alegra, I recommend standing the Amiga on its left side (after unplugging it, etc.) for maximum ease in connecting the StarBoard II.

The StarBoard II differs from the Alegra box in several important respects. First, it passes the expansion bus through, so that you can attach other expansion devices (like another StarBoard II). Second, you can put 1 megabyte of RAM in it with 256K-bit chips. Third, it can be upgraded to 2 megabytes without using 1-megabit chips; instead, an optional daughterboard (known as the Upper Deck) lets you double the number of 256K-bit chips in the box. Fourth, it has an optional MultiFunction Module

continued

Bruce Webster, a consulting editor for BYTE, can be reached c/o BYTE, P.O. Box 1910, Orem, UT 85057, or on BIX as bwebster.

NOW! FULLY FUNCTIONAL
XTURBO SYSTEMS
ALL COMPLETE WITH
HARD DRIVE AND
TTL AMBER MONITOR

10MB $845
20MB $949
30MB $995



No Hidden Costs, No Gimmicks
A True IBM Compatible at
Hundreds Below Competition
DELIVERED TO YOU FULLY
TESTED, AND READY TO RUN

TURBO SPEED 4.77/8 MHZ WITH
16-BIT 8088-2 PROCESSOR
PLUS THESE QUALITY FEATURES:

1. Dual Speed—Keyboard Switchable
2. 640K Mbrd., 256K RAM On Board
3. 8087 Co-Processor Socket
4. Eight Expansion Slots
5. 135-Watt Power Supply
6. Front Panel Turbo/Power/HD Lights
7. Can Boot-up in Turbo Mode
8. Unique, Heavy-Duty AT Style Case
9. Built-in Speaker
10. Runs all MS-DOS programs including 1-2-3, Flight Simulator, etc. and GW BASIC
11. Brand New (Not Rebuilt) Famous Brand Hard Drive and Controller Card
12. System Boots From Hard Drive
13. 360K Direct Drive (Not Belt Driven) Famous Brand Floppy Drive
14. Four-Drive (Not 2-Drive) Floppy Controller
15. AT-Style Keyboard, 84 Keys, LED Indicators and Large Return Key
16. Monographics (Hercules Compatible) Card W/Printer Port
17. High Resolution TTL Amber Screen Monitor
18. System Assembled and Diagnostic Tested in our Labs.
19. One-Full-Year Limited Warranty
20. 20-Day Return For Refund Policy

CALL NOW 415 527-5834
VISA • MASTER • COD

OLLA COMPUTER SYSTEMS, INC.
1224 TENTH STREET BERKELEY, CA 94710

that contains goodies like battery-backed clocks, a socket for a 68881 floating-point coprocessor, and a switch that turns the StarBoard II into a RAM disk that can survive a system crash and reset.

It took me only a minute or so to remove the Alegra and another few minutes to attach the StarBoard II. I powered up the Amiga and found myself with 2.5 megabytes of RAM—nice! The StarBoard II I've got doesn't have the Multi-Function Module, so I couldn't test that out, but the RAM itself seemed to behave perfectly.

I was going to put the Alegra away in the StarBoard's box but then realized that the StarBoard had the expansion bus coming out the side. So I just plugged the Alegra into the StarBoard. I had no way of securing the Alegra since I didn't have jackscrews long enough to reach through the StarBoard to the Amiga, but the Alegra bus connector seemed to hold snugly onto the StarBoard's expansion bus, and I placed the external disk drive so that it would press the Alegra against the StarBoard. I powered up again, rebooted, and now had a system with 3 megabytes of RAM.

The StarBoard II (with 512K bytes) is only $495, about $120 more than the Alegra unit (with 512K bytes). If you can afford the extra bucks, you probably should get the StarBoard II.

Marauder II

Discovery Software International was also at DevCon II (not to be confused with DefCon IV), showing off Marauder II, the latest version of its disk backup program for the Amiga. They were kind enough to give me a beta copy (it should be out in final release by now). I've tried it out, and it has copied every copy-protected program I've tried it on with absolutely no problem. I must confess that I breathe easier knowing that I can safely file away my master copies of Deluxe Paint, Instant Music, and other such programs. Every Amiga owner should have a copy for just that reason.

In a note of irony, Rick Ross of Discovery Software told me of their dismay over what has happened with another utility they've developed and released. Said utility is not copy-protected and has been heavily pirated. Ross is also getting tired of the constant escalation between software manufacturers, who want to protect their programs, and firms like his, who offer programs to help users make backup copies. Ross would like to see more firms go to the "random word" or "key wheel" form of protection. In these methods, the disk itself is not protected in any way. The owner is encouraged to make a working copy and to put the master away safely. Each time the owner runs the program, it requests a random word from a random page in the manual or asks the user to look up and enter a given value from a table or calculating wheel. This limits casual distribution of the program since each user has to have a copy of the manual or calculating wheel. Ross promises that his company will make absolutely no effort to unlock or crack this type of protection, that their concern is that the user be able to safely put master disks away, and that they do not condone piracy in any form.

I, for one, believe him. As a software developer, I am not thrilled by piracy; there's nothing like having a program you've worked on for a year and a half appear on a nationally known pirate bulletin board three weeks after its release. As an end user, I am not thrilled by protected disks that can (and do) get clobbered. I've been happy to see a number of firms drop copy protection; I just hope our community can reward that trust with some honesty and consideration.

Other Items

A number of products were shown in various stages of development. James Bayless of New Horizons Software showed ProWrite, an Amiga word processor with many Mac-like features. It is due out by the time you read this—but we all know how that goes. The beta version I have is far from complete and looks promising but for one problem: It uses interlace mode, which has an intolerable flicker. Adjusting the colors with the Preferences utility doesn't help since ProWrite sets its own colors. You probably want to wait until Commodore releases an Amiga that doesn't need interlace mode for high-resolution text processing . . . assuming that ever happens.

NewTek was also present. NewTek puts out DigiView, which lets you hook up a TV camera to your Amiga and produce hold-and-modify images. HAM pictures can have up to 4096 different colors on the screen simultaneously. They were showing a beta version of DigiPaint, which—as you might guess—is a paint program that works on HAM images.

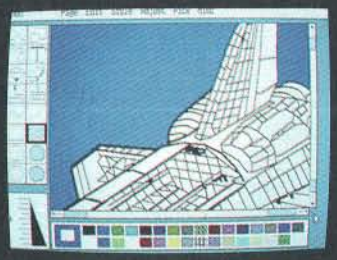
Some of you might not realize what a difficult feat a program like that is, so let me describe how HAM images are set up on the Amiga. A HAM image uses six bit planes, which means that each pixel—each colored dot on the screen—uses 6 bits to determine its color. If the first 2 bits are "00," the remaining 4 bits (yielding a value from 0 to 15) are used to look up the pixel's color in the color table (16 values chosen from the total palette of

continued

Inquiry 209
Inquiry 341 for End-Users.
Inquiry 342 for DEALERS ONLY. →

Unlock your desktop with Publisher's Paintbrush.™

Finally, a paint package designed for desktop publishing! When you create or scan a 300 dpi page, you'll get a 64-screen computer image. That's why Publisher's Paintbrush lets you zoom out and work on the big picture. So you get ultra-sharp resolution without ultra-tedious labor.



One screen of a 64-screen image.



Shrink down to a manageable size.



Next, cut-and-paste . . .

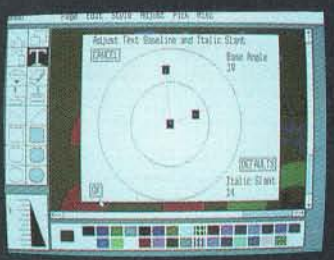


A few edits later . . . VOILA!

New typography frontiers: continuously adjustable point sizes, text slope, line and character spacing, extended and condensed type, and letter slant.



Easy-to-use menus.



Slant and angle text 1° – 359°.

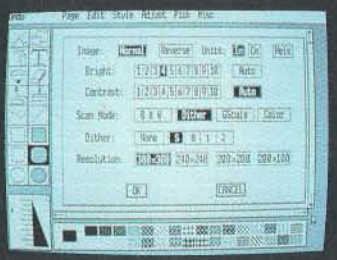


4- to 250-point type.

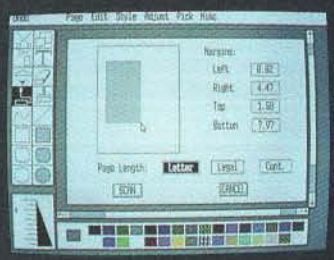


Adjustable everything!

Publisher's Paintbrush adapts to most scanners with absolute simplicity. Scan in existing art, logos and diagrams to save many hours of work!



Full use of scanner features.



Scan all or part of a page.



Combine art and type . . .



. . . from several sources!

Publisher's Paintbrush is a quantum leap in power beyond our top-selling PC Paintbrush®. In fact, it's the dawn of a new era for desktop publishing. With it, you can produce pictures of super-high resolution (many times sharper than your screen!) and marry them into text pages. With it, you can take full advantage of desktop publishing packages, laser printers and image scanners. Without it, you're stuck with ragged edges and tedious multi-screen editing.

Publisher's Paintbrush supports major-brand image scanners and hundreds of printers and video display boards. And most desktop publishing packages have built-in links to Publisher's Paintbrush.

Say goodbye to the old boundaries. Say "Show me" to your ZSOFT dealer. Or call our corporate offices for more information.

Publisher's Paintbrush is a trademark and PC Paintbrush is a registered trademark of ZSoft Corporation. Dover Clip-Art Series is a registered trademark of Dover Publications, Inc.

Z·SOFT

1950 Spectrum Circle, Suite A495, Marietta, Georgia 30067, (404) 980-1950

MAC INKER™

MAC INKER™, Automatic Ribbon Re-inker. Re-ink any fabric cartridge or spool for **less than 5 cents**. Over 70,000 in the field and we support **ALL** printers. Universal Cartridge or Universal Spool MAC INKER



$68.50. We have cartridges re-inkable in 10 colors. Ask for your printer type or for complete listing. Bottle ink $3.00/each. Shipping $3.00.

PROTEUS™, the 'Siamese' Buffer. It is a **Data Switch** with buffer on both ports. Switch manually or via software. Saves time, space and money. Or ask about our **MAC MASTER** line of Universal Buffers and Printer Controllers (serial or parallel up to 1 MEG).



PROTEUS 64 K-199.00
256 K-299.00 Shipping $4.00.
Of course we have **Data Switches**, serial/parallel, 2 way, 4 way, crossed etc., at most competitive prices (all lines switched).

CABLES priced $10-25. We carry cables for all common computers and peripherals. Rapid turn-around on custom orders.

MERCURY MODEM. Really 100% Hayes* Compatible. 300/1200 baud, speaker, full status light display and 2 years warranty. Includes **QUICK LINK**, easiest and most reliable Comms Software (available for IBM PC or Macintosh) **$149.00** Shipping $4.00.



*Hayes is a trademark of Hayes Microproducts.

MAC THE RIPPER. Our newest, original and welcome printer companion. Pulls off paper perforations and tears the sheets apart. Takes little space and will pay for itself almost immediately in saved time and tedium. Ask for brochure. Introductory Price **$299.00.** Shipping $10.00.

Order Toll Free.
Call or write for free brochure.
1-800-547-3303
In Oregon 503-626-2291 (24 hour line)
We are and always will be your
Computer Friends®
14250 N.W. Science Park Drive
Portland, Oregon 97229 Telex 4949559
Dealer inquiries welcome.

4096 colors). Each color has 4 bits' worth of red, green, and blue; that is, the color is described by combining one of 16 values of red, one of 16 values of green, and one of 16 values of blue. So far, not too impressive.

Now, if the first 2 bits are "01," the pixel has the same color as the one to its left, except the last 4 bits replace the red value in that color. If the first 2 bits are "10," the last 4 bits replace the green value in that color, and if the bits are "11," the last 4 bits replace the blue value in that color. This allows for subtle shading from left to right, which lets DigiView produce the sharp, colorful images that it does.

It's amazing enough that DigiView can produce a HAM image using a black-and-white video camera and red, green, and blue filters—then chooses the best palette of 16 colors and fills in with derived shades. To then be able to manipulate that image by drawing, cutting, pasting, repainting, and so on is remarkable. I have neither DigiView nor DigiPaint, so my comments are based on what I saw at DevCon. If you want more information, contact NewTek.

Four Books for the Amiga

I collect books, and I am always on the lookout for books that can teach me what I am too lazy to dig out on my own. For that reason, I have been collecting Amiga books lately, seeing what I can gain from them. I've picked up four so far; here are brief reviews of each.

The Amiga Programmer's Handbook by Eugene P. Mortimore (Sybex, 1986, $24.95) is meant to be a companion to (or interim substitute for) the Amiga ROM kernel and Intuition technical manuals. It contains a function-by-function listing of all the major libraries. For each function, the book lists the syntax of the function call, the function's purpose, its input parameters, and what the function is supposed to do. The book groups functions according to task: Exec, graphics, animation, text, layers, Intuition, and workbench.

My biggest complaint with this book is that it contains absolutely no code examples. Consequently, the book is insufficient to stand on its own; it needs other documentation to support it. Even so, it might make a good second text if you're getting stumped figuring out just what your program is supposed to be doing.

Inside Amiga Graphics by Sheldon Leemon (Compute! Publications, 1986, $16.95) aims at helping experienced programmers quickly get their hands dirty with graphics programming on the Amiga. It assumes a certain familiarity with C and/or BASIC, using examples in both languages to show you how to carry out tasks involving graphics.

This book isn't usable as a stand-alone text, but it obviously wasn't designed to be. It fills its niche well, introducing graphics but not going so far as to lose you. The C examples are not for the novice.

Inside the Amiga by John Thomas Berry (Howard W. Sams, 1986, $22.95) appears to be the best all-around text I've seen for the Amiga programmer. While neither perfect nor comprehensive, it does explore the major areas of the Amiga—Intuition, Exec, graphics, etc.—with lots of diagrams, example code, and other aids.

Unfortunately, the book has a number of quirks, and a fair amount of the information in it is outdated or wrong. I'm not sure the MAP and XREF listings of a sample link—occupying almost 40 pages—serve any useful function. Some of the C source examples take far more statements to accomplish their task than they should. At least one acquaintance of mine, involved with technical support for the Amiga, was very unhappy with the book. However, I'm not sure what else to recommend for now.

The Amiga by Michael Boom (Microsoft Press, 1986, $19.95) is subtitled "Images, Sounds, and Animation on the Commodore Amiga." Unlike the other three books, this aims squarely at the novice user who has bought the machine and is now wondering what to do with it. It is reminiscent of some early Macintosh books, with ties to specific software. *The Amiga* uses Amiga BASIC for its programming examples (all rather simple) and refers to Deluxe Paint, Deluxe Music, and Deluxe Video for its sections on art, music, and animation. (Not surprisingly, Trip Hawkins of Electronic Arts wrote the introduction.)

This is a good book for novice Amiga owners. It introduces many concepts well, has code samples and other helpful information, and just does a good job of introducing the Amiga without getting you lost in the maze of libraries and ROM calls.

COMDEX

A few days after getting back from the Amiga conference, I flew down to Las Vegas and COMDEX/Fall. This is the big trade show in the microcomputer industry, designed for dealers, corporations, and manufacturers more than for end users. And "big" is the operative word here; even at a brisk pace, I had to walk several hours to cover all the exhibits (located in the Las Vegas Convention Center and four hotels).

continued



All orders shipped within 24 hours!

SOFTWARE

ANSA
Paradox $450.00

AMERICAN SMALL BUSINESS SYSTEMS
Prodesign II $180.00

ASHTON-TATE
Dbase III + ... $407.00
Framework 410.00
Multimate 248.00
Multimate Advantage 315.00

BORLAND
Database Tool Box ..... $ 39.00
Graphics Toolbox 39.00
Lightning 61.00
Reflex 85.00
Sidekick 48.00
Super Keys 41.00
Turbo Jumbo Pack 175.00
Turbo Pascal (8087 + BCD) 65.00
Turbo Tutor 21.00

BPI
AR, AP, General Accounting and Payroll ..... $175.00 each
Inventory, Job Cost and Church Management ..... CALL

BREAKTHROUGH
Timeline $230.00
Timeline Graphics ..... CALL

BROWNBAG SOFTWARE
Homebase ..... $ 44.00
PC Outline 64.00
Utilities 93.00

CENTRAL POINT
Copy II PC ..... $ 24.00
Copy II Options Board 80.00
PC Tools 24.00

CHIP SOFT
TURBO TAX
Personal Federal ..... $ 45.00
Personal State ..... $ 28.00
Professional Federal $180.00
Professional State $120.00

COMPUTER ASSOCIATES *(I.U.S.)*
Easy Plus (windowing) ..... CALL FOR PRICES
Easy Systems Acctg. (per module) ..... CALL FOR PRICES
Supercalc IV ..... CALL FOR PRICES
Super Project Plus ..... CALL FOR PRICES

COSMOS
Revelation $500.00

DAC
Easy Accounting ..... $ 48.00
Easy Payroll 36.00
Payroll Tutor 14.00
Accounting Tutor 14.00

DIGITAL RESEARCH
Gem Collection ..... $ 75.00
Gem Desktop 30.00
Gem Draw Plus 190.00
Gem Graph 148.00
Gem Wordchart 88.00

EXECUTIVE SYSTEMS
X Tree ..... $ 29.00

FIFTH GENERATION
Fastback ..... $ 95.00

FINOT GROUP
Keep Track Plus ..... $ 58.00

FUNK SOFTWARE
Sideways ..... $ 37.00

HARVARD
Presentation Graphics $230.00
Total Project Manager 280.00

HOWARD SOFT
Tax Preparer $199.00
CA Sup. 80.00

IBM
DisplayWrite IV $360.00
DOS 3.1 ..... 65.00
DOS 3.2 ..... 80.00

JAVELIN
Javelin ..... CALL

LATTICE
C Compiler $250.00
Run C 94.00

LEADING EDGE
Word Processor w/Mail
Merge & Spell 80.00

LOTUS CORPORATION
Lotus 1-2-3 ..... $305.00
Lotus Report Writer 110.00
Symphony 435.00
Symphony Spell Checker 105.00
Freelance Plus 355.00
Graphwriter 320.00
Hal 109.00

MECA
Managing Your Money $119.00

MERIDIAN
Carbon Copy $109.00
(minimum of two pieces)

MICROGRAPHX
In-A-Vision $275.00
PC Draw 220.00

MICROPRO
Propak 245.00
WordStar 175.00
WordStar 2000 ..... 245.00
WordStar 2000 Plus 290.00

MICROPROSE *(strategic games:)*
Crusade in Europe ..... $ 25.00
Decision in the Desert ..... $ 25.00
F-15 Strike Eagle 22.00
Silent Service 22.00
Solo Flight 22.00

MICRORIM
R:Base System V $365.00

MICROSOFT
C Compiler (Version 4) $265.00
Chart 185.00
Cobol Compiler 415.00
Fortran Compiler 215.00
Macro Assembler 90.00
Multiplan 125.00
Project (Version 3) 265.00
Quick Basic 62.00
Windows 62.00
Word (Version 3.1) 285.00
Flight Simulator 33.00
Learning DOS 32.00

MICROSTUF
Crosstalk XVI ..... $ 99.00
Crosstalk Mk IV 155.00

NASHOBA
Nutshell $105.00

NEW ENGLAND SOFTWARE
Graph-in-the-Box (Pro) ..... $ 55.00
Graph-in-the-Box (Unpro) 85.00

NANTUCKET
Clipper $345.00

PAPERBACK SOFTWARE
VP-Planner ..... $ 55.00
VP-Info 55.00

PAUL MACE SOFTWARE
Mace Utilities ..... $ 62.00

PETER NORTON COMPUTING
Norton Commander ..... $ 39.00
Norton Utilities 52.00

QUAID SOFTWARE
Copywrite (w/zero disk) ..... $ 38.00

ROSESOFT
Prokey ..... $ 75.00

SIMON & SCHUSTER
Typing Tutor ..... $ 32.00
Webster Spell Check 35.00
Webster Thesaurus 45.00
New World Writer 79.00

SOFTLOGIC
Carousel ..... $ 30.00
Cubit 30.00
Disk Optimiser 30.00
Double DOS 30.00

SOFTSTYLE
Printworks ..... $ 38.00
Printworks (laser) 68.00

SOFTWARE GARDENS
Dan Bricklin's Demo Program ..... $ 60.00

SOFTWARE GROUP
Enable $335.00

SOFTWARE PUBLISHING
First Choice ..... $ 90.00
Pro Writer 115.00
Pro File 142.00

SOFTWARE RESEARCH TECHNOLOGY
Smartkey ..... $ 36.00
Smartkey w/Smartprint 49.00

SOFTWARE TOOLS
Viewgen (Version 2) ..... $ 95.00

SPRINGBOARD
Newsroom Pro 79.00
Certificate Maker 36.00

STERLING SOFTWARE
Intelligent Backup ..... $ 80.00

SUMMIT
Better Basic $155.00

SYMANTEC
Q & A $235.00

T/MAKER
Click Art Personal Publisher $115.00

TURNER HALL
SQZ ..... $ 58.00
Note It 58.00

UNISON WORLD
Art Gallery I ..... $ 21.00
Art Gallery II 24.00
PrintMaster 32.00
Newsmaster 55.00

WORDPERFECT CORP.
WordPerfect $215.00
WordPerfect Library 64.00

WORDTECH
Quicksilver $325.00
MS DOS Libraries 52.00
LAN File Server 70.00
DBXL ..... CALL

XEROX
Ventura Desktop $675.00

HARDWARE

AMDEK
310A $149.00

AST *(expansion cards)*
Rampage AT 445.00
Rampage PC 260.00
Six Pack 165.00

C. ITOH *(printers)*
C310 ..... CALL
C315 ..... CALL

FUJITSU
P.C. Half Height Drive ..... $ 85.00

HERCULES
Graphics Plus 185.00

IBM
ProPrinter $420.00
ProPrinter XL 650.00

IMSI
PC Mouse & Dr. Halo II $105.00

INTEL
Above Board AT 128 ..... $375.00
Above Board PC 64 ..... 240.00
Above Board PS 256 ..... 340.00
8087 (IBM) 115.00
8087 (8 mhz.) 160.00
80287 ..... 185.00

MICROSOFT
Mouse (serial) $127.00
Mouse (bus) 120.00
Mach 10 ..... 285.00

NEC
1401 Multisync Monitor $595.00

PARADISE
EGA Auto Switch $390.00

PLUS
The Hard Card 20 meg $710.00

PRACTICAL PERIPHERALS
Modem 1200 (Internal) $130.00
Modem 1200 (External) 170.00
Multifunction Card w/1200 Modem 300.00
Complete System 160.00

SEAGATE
20 MB. Hard Drive w/Wd. Controller $445.00

SIGMA DESIGNS
EGA Card $390.00

TOSHIBA
321 ..... $465.00
341 ..... 750.00

U.S. ROBOTICS
Direct 1200 (ext.) $125.00
Direct 1200 (int) 110.00
Direct 2400 (int) 195.00

CABLES

6-ft. Modem Cable ..... $ 15.00
6-ft. Parallel Printer Cable 15.00
Surge Protectors 24.00

TERMS:
- No surcharge. Visa or Mastercard.
- Add $2.00 for C.O.D.—All C.O.D. cash or certified check only.
- Prices subject to change without notice.
- Short shipments must be reported to us within 24 hours of receipt.
- Non-defective goods must be returned with seals intact within 10 days of receipt for full refund.
- Shipping costs will not be refunded.
- No returns accepted without RMA #.
- No returns on non-defective hardware.
- Management reserves the right to charge up to 10% restocking fee.
- Shipping charge $3.00 per item in California; $4.00 per item elsewhere. This does not apply to bulk orders. Shipping costs for hardware items will be higher.
- Terms extended to *Fortune 1,000* companies, government institutions, schools and universities.

INQUIRIES: **818·881·6096**
ORDER ONLY: **800·225·8084**
6925 Canby Street, Suite #103, Reseda, California 91335

Inquiry 361

Inquiry 5



AMERICAN MADE IBM AT COMPATIBILITY
and
10 MHz POWER
$1595!

1 YR PARTS/
LABOR WARRANTY.
SATISFACTION GUARANTEED.
BEST CUSTOMER SERVICE
IN THE INDUSTRY.

LOW PRICES
FOR GUARANTEED QUALITY!

ADTEK ATi SYSTEM (1MB/10MHz) w20MBHD	$1984
ADTEK ATi SYSTEM (1MB/10MHz) w40MBHD	2395
ADTEK ATi SYSTEM (640K/8MHz) w1.2MFD	1395
ADTEK ATi SYSTEM (640KB/8MHz) w20MBHD	1784
ADTEK ATi SYSTEM (640KB/8MHz) w40MBHD	2195
TURBO XT SYSTEM (512KB/8MHz) w360KFD w/1pp, 2 sp, FD controller, clock/ calendar, battery backup, reset button on MB, 6 full size expansion slot in this configuration	859
TURBO XT SYSTEM (640KB/8MHz) w20MBHD	1395
MITSUBISHI/TEAC 360KFDD (for AT)	109
MITSUBISHI/TEAC 360KFDD (for XT)	99
60MB Tape Backup	899
AT I/O EXP. CARD 1-SER/1-PAR	89
SECOND SERIAL PORT FOR I/O CARD	29
AT MFUNC. CARD/WITH OKB/1-SER/1-PAR	229
COLOR CARD	99
MONO/GRAPHICS CARD W/PRINTER PORT	99
GENOA SPECTRUM GRAPHICS CARD	255
EGA COMPATIBLE CARD	299
EGA COMPATIBLE CARD/W PRINTER PORT	339
12" MONOCHROME MONITOR (AMBER)	109
12" TAXAN 630 WITH 553 CGA CARD	599
14" MITSUBISHI CGA MONITOR	319
14" MITSUBISHI EGA MONITOR	449
14" NEC MULTISYNC EGA MONITOR	569
AT/XT MAXI-SWITCH K/B	75
NEC V20-8 for TURBO XT	19
8MHz Math co-processor for AT	299
8MHz math co-processor for XT	159

Write or call for FREE brochure and price list of ADTEK's full line of ATi/XT Systems and Accessories.

IBM AT is a registered trademark of International Business Machines Corp.

ADTEK TELECOMMUNICATIONS CORPORATION
3706 Realty Road
Dallas, Texas 75244
(214) 241-5811

Items Discussed

Advanced Personal Computer System ..... $10,000+
Datavue Technical Systems
4355 International Blvd.
Norcross, GA 30093
(404) 564-5780

DASCH (for the Macintosh) ..... $395 to $545
Western Automation
1700 North 55th St.
Boulder, CO 80301
(303) 449-6400

DigiView $199.95
DigiPaint ..... Price unknown
NewTek
701 Jackson, Suite B3
Topeka, KS 66603
(913) 354-1427

Marauder II $39.95
Discovery Software International
903 East Willow Grove Ave.
Wyndmoor, PA 19118
(215) 242-4666

ProWrite $124.95
New Horizons Software
P.O. Box 43167
Austin, TX 78745
(512) 280-0319

StarBoard II
with 512K bytes $495
with 1 megabyte $595
with Upper Deck and 2 megabytes $879
Upper Deck (with 0K bytes) $99.95
MultiFunction Module (without 68881) $99.95
MicroBotics Inc.
P.O. Box 855115
Richardson, TX 75085
(214) 437-5330

A few trends were obvious. IBM PC clones keep getting cheaper. Several booths were advertising AT clones—not PC, but AT—for much less than $1000. A number of firms, including most of the major clone makers, were showing 80386-based systems. Unfortunately, it looks as though said manufacturers can't agree upon a 32-bit bus standard, which will probably leave them all at the mercy of IBM. They appear to be too concerned about short-term gain to worry about long-term survival.

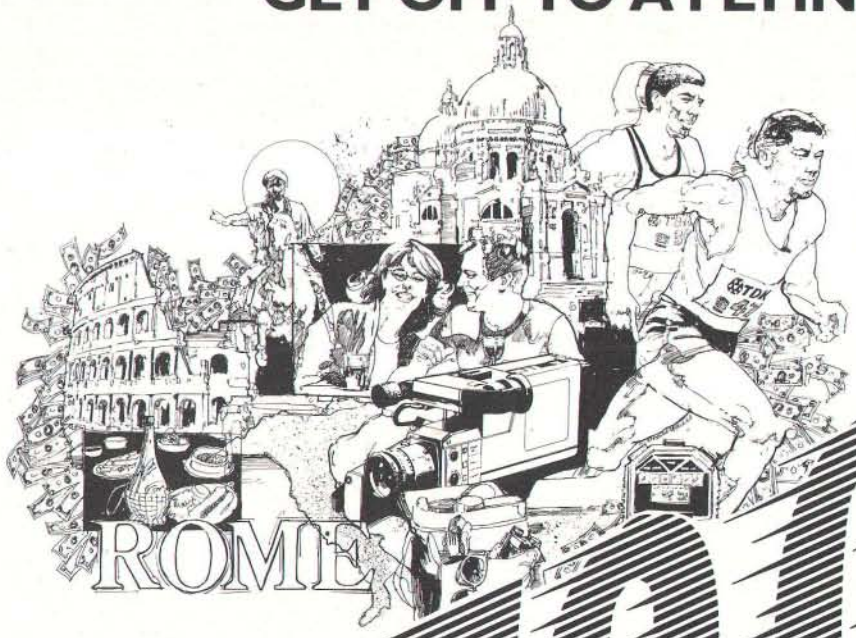
Another buzzword appearing in just about every microcomputer manufacturer's booth was "desktop publishing." Most people seemed to think that desktop publishing meant word processing on a high-resolution, reverse-video, monochrome monitor (in unconscious emulation of the Macintosh). Unfortunately, the state of the art in desktop publishing on MS-DOS machines isn't very impressive, at least compared to that found on the Mac. Why? Because the basic concepts of clipboard, scrapbook, and resource type are inherent in the Mac operating system and ROM routines, making it easy for applications developed by different firms to pass text and graphics back and forth. An item in the Microbytes conference on BIX reported that two different IBM PC users groups were now using Macs to do their newsletters, one of the groups doing so after having tried "desktop publishing" on an IBM PC and having found it wanting.

And speaking of the Mac . . . Apple pulled out of COMDEX, so they weren't there to push their vision of desktop publishing. Bad move, since it means that at-

continued

RUN AWAY TO ROME

GET OFF TO A FLYING START



WITH TDK'S

$450,000

DASH FOR CASH SWEEPSTAKES

See world-class athletes perform in Rome while you continue to get a world-class performance from your quality TDK floppy disks.

2-$50,000 GRAND PRIZES

If you're one of the lucky Grand Prize winners in TDK's "Dash for Cash" Sweepstakes, you'll receive a fully paid, 8-day/7-night deluxe trip for 2 to the World Championships in Athletics to be held in Rome August 29-September 6, 1987. It includes round-trip airfare via Alitalia Airlines, luxury hotel accommodations and 2 VIP passes to the games as guests of TDK. All this plus $40,000 in cash!

5-FIRST PRIZES

Five lucky first prize winners will win a fully paid Grand Prize trip for 2, complete with airfare, luxury accommodations and 2 VIP passes, compliments of TDK. Plus $5,000 in cash!

50-SECOND PRIZES

Each of 50 second prize winners will receive a State-of-the-Art Video Camcorder to record their favorite live sporting events or special family moments.

5,000-THIRD PRIZES

5,000 avid sports fans will receive a lightweight insulated sports cooler that keeps your favorite liquid refreshment as hot or cool as you like it.

15,000-FOURTH PRIZES

15,000 runners-up can keep tabs on the pace with a sporty high tech digital stopwatch that keeps track of time with pinpoint accuracy.

Go to your TDK dealer today and pick up your entry coupon in specially marked packages of TDK floppy disks or write for entry coupon and official rules to "DASH FOR CASH," P.O. Box 2312, Yonkers, NY 10703. Include a self addressed, stamped envelope, except residents of Washington and Vermont. One request per envelope. All requests for entry coupons must be received by June 1, 1987. No purchase necessary. All entries must be received by midnight June 30, 1987. Void where prohibited.



world championships in athletics 1987 rome august 29-september 6

TDK

OFFICIAL FLOPPY DISK SUPPLIER TO THE WORLD CHAMPIONSHIPS IN ATHLETICS ROME, ITALY.

TDK®

THE NO-RISK™ DISK.

tendees who haven't used the Mac (and who missed the Aldus/PageMaker booth) didn't have a chance to see just what the Mac can do. Commodore wasn't there (again), and Atari was (again). Rumor has it that Commodore didn't have a booth because the Interface Group refused to allow them to let third-party developers exhibit in their booth. If that's true, it might also explain Apple's pullout, since Apple pioneered that concept. Then again, Atari did it anyway; but there were rumors of a heated exchange on the floor between the Interface Group and Atari officials. If all this is true, it shows a lot of shortsightedness on the part of the Interface Group. After all, the Atari booth was one of the most crowded in the show—even on the last day—when many other booths looked deserted.

I stopped by the Western Automation booth. This firm makes the DASCH external RAM disk for the Macintosh, which I reviewed in the June 1986 BYTE. When I wrote that review, the prices for the 500K-, 1000K-, and 2000K-byte versions were $495, $795, and $995, respectively; they have now come down to $395, $450, and $545. Since the DASCH has an external power supply, you can power your Mac down (or have it crash) and not lose anything. At $545, a 2-megabyte RAM disk could do wonders for development speed.

A number of firms were claiming to have the "world's fastest personal computer." Several companies with 80386-based systems were bestowing that crown upon themselves. The folks at Levco ran some benchmarks on their Prodigy 4 (16.67-megahertz 68020 Mac upgrade) and on a Compaq 386 and documented themselves as being faster. But the winner (though not yet shipping) was probably the Datavue Advanced Personal Computer System. The computer—an IBM PC compatible—uses a discrete logic implementation of an 8086 processor, which they call their 86150 CPU. This CPU consists of two large (about 12 by 15 inches) boards in a box that sits under a regular AT-like system. Datavue claims that the processor executes instructions at a speed equivalent to a 150-MHz 8086—about 15 times faster than an IBM PC AT. Anticipated cost is in the $10,000+ range, but hey, you know how these power users are.

In the Queue

Two hardware reviews are coming up next month: the PAL expansion chassis for the Amiga and the Magic Sac (Macintosh emulator) for the Atari ST. I'll also have a few software reviews and other bits and pieces. Until then, see you on the bit stream. ■

A Message To Our Subscribers

FROM TIME TO TIME WE MAKE THE BYTE SUBSCRIBER list available to other companies who wish to send our subscribers material about their products. We take great care to screen these companies, choosing only those who are reputable, and whose products, services, or information we feel would be of interest to you. Direct mail is an efficient medium for presenting the latest personal computer goods and services to our subscribers.

Many BYTE subscribers appreciate this controlled use of our mailing list, and look forward to finding information of interest to them in the mail. Used are our subscribers' names and addresses only (no other information we may have is ever given).

While we believe the distribution of this information is of benefit to our subscribers, we firmly respect the wishes of any subscriber who does not want to receive such promotional literature. Should you wish to restrict the use of your name, simply send your request to the following address.

BYTE MAGAZINE
ATTN: SUBSCRIBER SERVICE
P.O. BOX 6821
PISCATAWAY, NJ 08854



BACK ISSUES FOR SALE

	1985	1986	1987
Jan.	$4.25		$4.25
Feb.	$4.25	$4.25	$4.25
March	$4.25	$4.25	
April	$4.25	$4.25	
May	$4.25		
June	$4.25	$4.25	
July		$4.25	
Aug.	$4.25	$4.25	
Sept.	$4.25	$4.25	
Oct.	$4.25	$4.25	
Nov.	$4.25	$4.25	
Dec.	$4.25	$4.25	

SPECIAL ISSUES and INDEX	
BYTE '83–'84 INDEX	$1.75
BYTE 1985 INDEX	$2.00
1984 SPECIAL GUIDE TO IBM PCs (VOL. 9, NO. 9)	$4.75
1985 INSIDE THE IBM PCs (VOL. 10, NO. 11)	$4.75

Circle and send requests with payments to:

BYTE Back Issues
P.O. Box 328
Hancock, NH 03449

☐ Check enclosed
Payments from foreign countries must be made in US funds payable at a US bank.

☐ VISA ☐ MasterCard

CARD # _____ EXP. DATE _____

SIGNATURE _____

The above prices include postage in the US. Please add $ .50 per copy for Canada and Mexico; and $2.00 per copy to foreign countries (surface delivery). Please allow 4 weeks for domestic delivery and 12 weeks for foreign delivery.

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

Scan-tastic!

Introducing ShapeScan. Only $795 a bundle.

Until now, when you shopped for a scanner, you'd need to carry along a calculator. First you'd use it to figure out how to justify a base price in the range of a good computer. Then you'd have to total up all the salesperson's add-ons.

"Oh, by the way," the sales rep would say, "you'll need an interface card." Add about $300.

"'Oh, by the way, you'll need an interface cable." Add $50 or so.

"Oh, by the way, you'll probably want a graphics editor." Add $150.

Now you don't need a calculator – or a fat bank account – to buy a scanner. ShapeScan is priced hundreds of dollars under competitive models. Better yet, there are no "Oh, by the way" add-ons. ShapeScan bundles together everything you need for image scanning and editing. At one incredibly low price. No surprises.

Besides saving you money up front, ShapeScan will save you time for years to come. Because it turbocharges your personal productivity. In less than a minute, it captures artwork that would take you many hours to recreate on your computer. Ditto for logos, fancy typography, graphs and charts, engineering diagrams, documents, or whatever.

Scan, then paint.

Most scanners just scan. Then they call it quits. But since ShapeScan includes the top-selling PC Paintbrush® +, you have all the tools to turn a scanned-in computer image into your own masterpiece. Get creative! Rotate or flip the image, expand or shrink it, color it, and zoom in on a portion of it. Cut, paste, and add headings, text, lines, circles, or boxes. You can even import art or text from other systems, and export your completed creations to a desktop publishing system.

So don't pay big bucks for a scant scanner. Get ShapeScan – the total solution at a price that's absolutely scantastic. Call 800-247-1724 today.

Dealer inquiries invited.

Scanned-in computer image

PC Paintbrush + goes to work

A masterpiece!



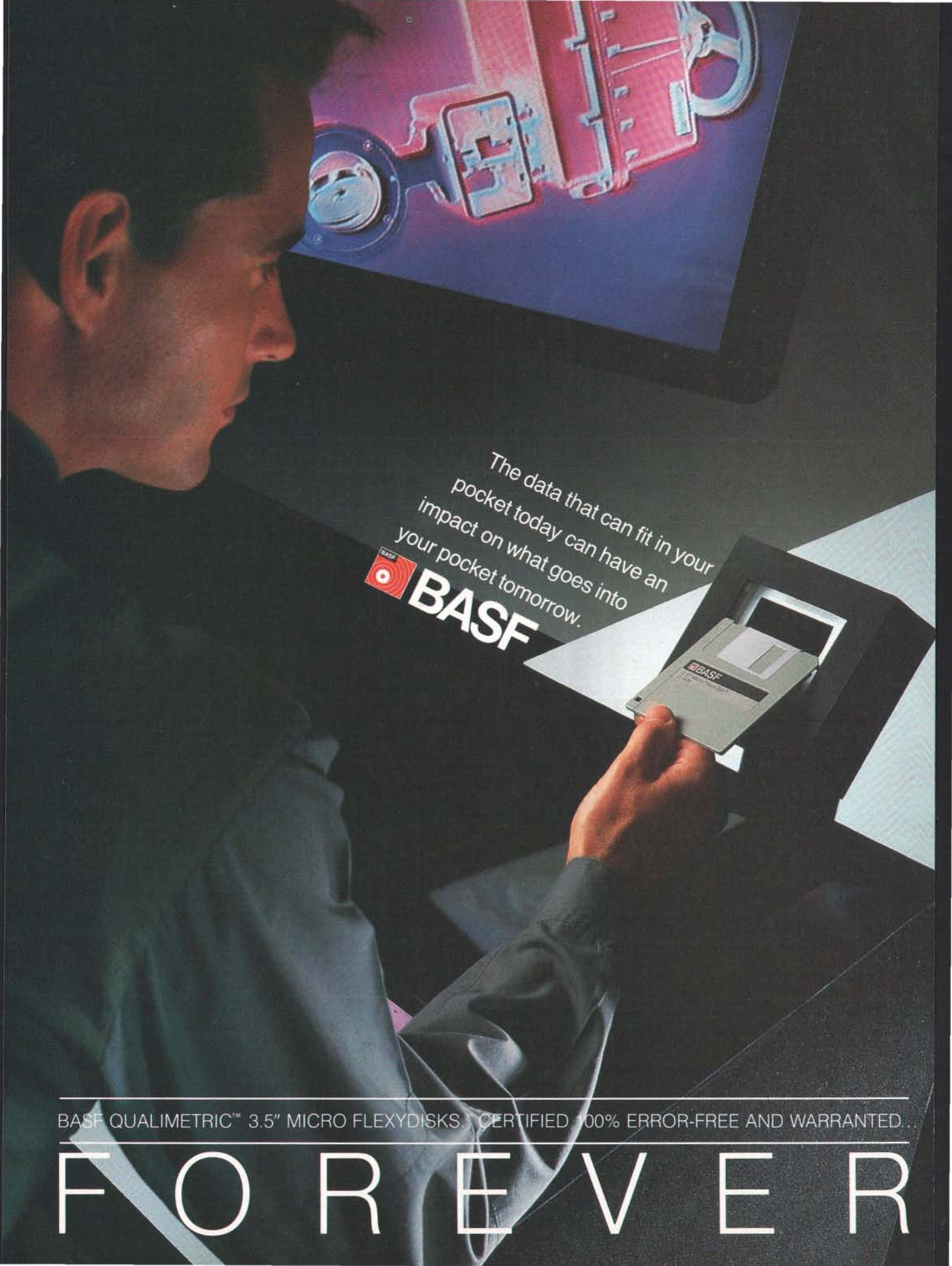
The scanner has one moving part, so it's the ultimate in reliability and ease of use. Price also includes PC Paintbrush +, interface card, and interface cable.

SHAPE®

PC Paintbrush is a registered trademark of ZSoft Corporation.
IBM PC/XT/AT are registered trademarks of International Business Machines.

Inquiry 343 for End-Users.
Inquiry 344 for DEALERS ONLY.

Made in USA


The data that can fit in your
pocket today can have an
impact on what goes into
your pocket tomorrow.
BASF
BASF QUALIMETRIC™ 3.5″ MICRO FLEXYDISKS™ CERTIFIED 100% ERROR-FREE AND WARRANTED...
FOREVER

CHAOS MANOR MAIL

Conducted by Jerry Pournelle

Amiga Defense

Dear Jerry,

In your December 1986 column you commented about Activision's Little Computer People and said ". . . I don't think the current version of Amiga's operating system has the answer."

The problem is that the Amiga's operating system is getting blamed for faults in applications programs. Allow me to use the example of Little Computer People.

The program was translated from 8-bit versions and 8-bit operating systems. In most of those operating systems, what happens if a file is not found or if the disk is write-protected? The program either gives a message (the preferred result) or crashes. Either way, the programmer is responsible for what goes on.

In the case of the Amiga, a requester pops up and asks for the correct disk, or to remove write-protection, or whatever. This removes the programmer's responsibility of protecting the user from such problems. The programmer can take control of such things or, if the programmer is lazy, he can just leave it to the OS.

The sad part is that the system calls make it so easy for the programmer. In other words, what you thought was caused by the OS was really the fault of a lazy (or careless) applications programmer. If you don't have them already, get the Addison-Wesley Amiga manuals and the AmigaDOS manual from Bantam. Take a half-hour sometime and scan the Intuition manual and you'll see some examples of what I'm trying to say: The stuff is there, but some of the early programs we're seeing don't use it!

I have enclosed a disk with select choices of programs from the public domain. Just put it in instead of Workbench. (Since I don't yet have version 1.2 of the OS, use the 1.1 version with this disk.)

Warren Block
Chadron, NE

I'd love to agree with you. People seem to have the notion that I've got it in for the Amiga and nothing could be further from the truth. I wish it well.

However, the software is suitable for hackers and hobbyists, but not for the rest of us.

I have several versions of the Amiga Kickstart program. Each works only with the corresponding Workbench. Although many Amiga programs will run with the newest Kickstart 1.2, not all will. You have to figure out which to use.

You blame the programmers and, of course, you're right. The fact is, though, that programs ported over to the Atari tend to work; those ported over to the Amiga tend to have problems. It may well be that the Amiga attracted a disproportionate share of bad programmers, but another explanation is that the Amiga is just harder to program for.

It may be worth the extra effort and skill required, of course. It can be spectacular. But it's not easy.

For example, I went in and fired up the Amiga with Kickstart 1.1, and inserted the disk you sent me. After the machine trundled awhile, I got

```
Can't Cancel DF1
Assign failed returncode 20
```

I don't know what that means, and I suspect most of us don't want to find out.

The Amiga will be a wonderful machine for the rest of us when it gets an operating system for the rest of us. Until then, I recommend it for people who like to find out what returncode 20 *means.*—Jerry

Flash: I later found out you'd done a no-no on that disk; also that AmigaDOS 1.2 is a bit more stable. It's still harder to port to Amiga than Atari.

Turbo Denmark?

Dear Jerry,

For several years now, many people here in Denmark have been puzzled by the mysterious similarity between computer programs marketed by Borland International and programs marketed here by Poly Data some time in advance. Turbo Pascal, for instance, was somewhat disappointing to me when first marketed, as it was clearly an outdated version of Compas Pascal (now Poly Pascal), an old friend of mine.

The differences between the two products have diminished over time, although Poly Pascal is still a somewhat more polished product. The likeness is not superficial. A close inspection of the inner workings of the two compilers show them to be different only in minor details.

Now a similar situation seems to have

continued

EARTH LAUNCHES NEW STARS

EARTH COMPUTERS launches two of the "Hottest" new stars in the S-100 Universe. Both the **TURBOMASTER 8™** and **TURBOSLAVE I™** are Star Performers, featuring high-speed Z80H CPUs.

EARTH's new stars are fully compatible with the Multi-user TurboDOS operating system, and will operate in most S-100 systems including pre-IEEE-696 systems.

TURBOMASTER 8

This outstanding new 8-Bit Single Board Computer offers features that are out of this world:

- On-board ST-506 Disk Controller
- TurboDOS, CP/M, MP/M Compatible
- 5-1/4" and 8" Floppy Controller
- Up to 256K of memory • 2 Serial
- 8MHz CPU • 1 Parallel Port

TURBOSLAVE I



The perfect companion to the TURBOMASTER 8 or other 8/16-Bit master processor. This high-speed slave utilizes an 8MHz Z80H CPU and offers extensivey exclusive.

- No paddle boards
- S-100, IEEE-696 comp.
- 2 RS-232 ports, 50-38.4K Baud
- FIFO communications

EARTH also manufactures a growing line of PC compatible stellar performers such as:



- **TURBOSLAVE PC™** - an 8 MHz Z80 Single Board Slave that runs CP/M applications on a PC and is compatible with the TurboDOS multi-user operating system.
- **PASSION-286™** - a high perfomance 80286 accelerator that boosts PC performance up to 5 times for only $395.
- **EARTHNET PC™ & EARTHNET S-100™** - the low-cost ARCNET compatible way to tie PC and S-100 systems together.

To put these stars to work for you, call or write EARTH COMPUTERS **BE SURE TO ASK ABOUT HOW YOU CAN WIN A FREE Z-80 CO-PROCESSOR BOARD.**

EARTH COMPUTERS

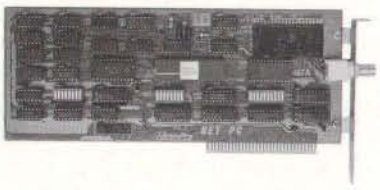
P.O. Box 8067, Fountain Valley, CA 92728
TELEX: **910 997 6120** EARTH FV

(714) 964-5784

Ask about EARTH COMPUTERS' other fine PC and S-100 compatible products.

The Better Net

The CompuPro ARCNET® PC Board



Better Compatibility

The **CompuPro ARCNET PC** is compatible with all versions of Novell Netware and Advanced Netware™, *and* DR-NET™ running in all types of PC-compatibles. No other board can say that!

Better Reliability

The **CompuPro ARCNET PC** board offers distinctly more reliability than other boards. Why? Read on.

Better Design

The **CompuPro ARCNET PC** board uses unique circuit design to increase signal margins. Better interface circuitry insures operation with even the fastest PC-compatibles.

Better Specs

The **CompuPro ARCNET PC** board meets all FCC requirements!

Better Made

The **CompuPro ARCNET PC** board is manufactured, tested and burned in right here in the USA. It is not subject to the wide swings in quality often experienced with foreign-manufactured boards.

Better Value

All of this adds up to the fact that the **CompuPro ARCNET PC** board is the best value in Novell compatible network boards.

Better Call Today

Call us today for the name of your nearest **CompuPro** dealer. They are prepared to discuss a variety of network and multi-user solutions to meet your requirements.

CompuPro™

Viasyn Corporation
26538 Danti Court
Hayward, CA 94545-3999
(415) 786-0909
TWX: 510-100-3288
Easylink Mailbox 62877579

Trademarks: CompuPro: Viasyn Corporation. ARCNET: Datapoint Corporation. Netware, Advanced Netware: Novell, Inc. DR-NET: Digital Research Inc.

arisen concerning Turbo Prolog and PC Prolog from Poly Data. What is going on?

There is no doubt in my mind that at least several of the Borland products are developed over here, but what is more interesting is this question: Is Borland International in reality a Danish company? And how about the mysterious Frank Borland? If he exists, maybe he isn't American after all!

Sven Korsgaard
Odense, Denmark

Fascinating. In fact, there has never been any such person as Frank Borland. When I first asked Philippe Kahn about the origin of the company name, he said "It's an Irish company and Borland is an ancient name for Ireland." This was before any but a handful of people had ever heard of the company.

He also told me some tales of the origin of Turbo Pascal. These stories tend to be, uh, fanciful, particularly the parts about Philippe's contributions to the code itself.

I later found out where SideKick and SuperKey came from: not internal development at Borland, as is usually thought. For that matter, some of the connections between Borland, Kahn, and ETH (Swiss Federal Institute of Technology) in Zurich are better remembered by Philippe than by the professors and staff at ETH.

In other words, Philippe Kahn is a master of marketing and will go down in history as such. The products are reliable, and he does in fact write a good part of the documentation himself. He sells good stuff at good prices. However, I tend to buy salt by the kilo when listening to stories about the origins of the products.

I've heard before that Turbo Pascal was originally a Danish product. I know for a fact that SideKick and SuperKey were not. I do know I use all three and I still say Philippe Kahn and Borland have done a great deal of good for this industry.
—Jerry

BASICally, What I Said ...

Dear Jerry,

You said in your December 1986 column that you throw out anything written in BASIC. (Well, you didn't state it that firmly, but the implication was strong.)

We have developed a business records program in BASICA (compatible with GW-BASIC) for the IBM PC. This was done for internal use and provided ledger record keeping and invoicing. Like many small in-house projects, the program was ultimately coveted by other small businesses. We improved it, and now it is distributed by Dynacomp Inc. It is not a great, multifunctioned, stand-alone accounting system for all businesses; on the other hand, we have reduced the direct price from $59.95 to $9.95. It is a good, graceful program for the record-keeping needs of many small businesses. I would like to send you a copy, but if it is just going to be thrown away, I won't waste your time or mine....

Paul Horvick
Minneapolis, MN

No, no. What I said was that I throw out disks that arrive without documents and prove to be games with BASIC choose-a-number player interfaces. Incidentally, most of that stuff is on such cheap media that I won't even put them in my machine for fear it will mar the disk heads.

Some very good programs are written in BASIC. Even better ones are written in QuickBASIC or other compiled BASIC. I wrote my *accounting system in CBASIC.*

Accounting programs had better have decent documents, though; I don't see how you can afford to sell it at that price. But, by all means, send a copy.—Jerry

Computer Shopping War Stories

Dear Jerry,

I recently moved from Jacksonville, Florida, to the Philadelphia area. One of my first activities was locating all the local computer stores as groundwork for purchasing a computer for software development and general office use, as part of a consulting deal I won up here.

Your advice, "If you don't know what you're doing, buy from those who do," needs the addition, "if you can find someone who knows and cares!"

I settled on three criteria for my new office computer: It must be able to handle at least two users, run good versions of UNIX, and have acceptable Pascal, FORTRAN, and C compilers available. Figuring that since I had been allocated a mean figure of $6000 to spend, I might as well go for service and support, I went to ComputerLand. Huge mistake number one.

Upon entering the store, I was ignored for five minutes. Then I touched a computer and had instant attention.

Now, I may be a lone stranger in a different state, but I do not consider it polite for a salesperson to open with the question "Hello. How much money do you want to spend?" But I considered the different cultures and manfully set the perceived slight aside and answered "Oh, I don't know. It depends on what you have, I suppose."

Talk about getting off on the wrong foot. I finally convinced this person that I was serious only after I named $5000 as the figure and was asked what kind of system I wanted. I named my three speci-

continued

Get the Courier HST™ 9600-bps modem. Then watch the rest of the world play catch-up.



USRobotics new high speed technology delivers over 1,000 characters/second on more dial-up phone lines. For less than $1,000.

The new Courier HST (High Speed Technology) dial-up modem combines four great ideas that add up to a new standard for personal computer data communications.

It's full-duplex, with high speed (9600-bps) and low speed (300-bps) channels—automatically assigning the high speed channel direction. This asymmetrical solution avoids the problems of echo-cancelling technology or inefficient half-duplex schemes.

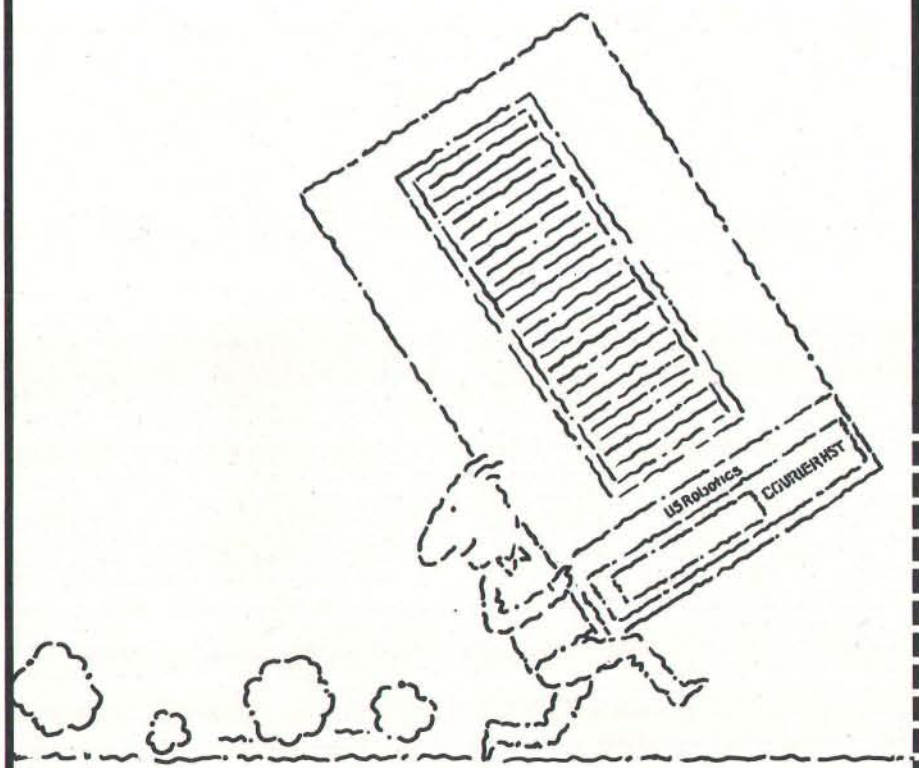
The most powerful data signalling technique—Trellis Encoded Modulation—lets Courier HST achieve maximum speed over a much wider range of phone line conditions than other 9600-bps modems.

A unique error- and flow-control method allows Courier HST to send up to 1,100 characters a second over long distance phone connections.

It's familiar as any 2400- and 1200-bps modem. Same features, commands and, in most cases, the same software. In fact, Courier HST automatically falls back to 2400, 1200 and 300-bps, connecting you with nearly all modems.

High speed. High accuracy. High value. And a two-year parts and service warranty. Get the USRobotics Courier HST, priced under $1,000. And watch the rest of the world play catch-up.

CALL 1-800-DIAL-USR
In Illinois (312) 982-5001



Yes, please send me your FREE 8-page book explaining the new Courier HST and today's new high speed technology.

Name_____

Title_____

Company_____

Address_____

City_____ State____ Zip_____

Business Phone ( )_____

4/87-BY-2400F

US Robotics™
The Intelligent Choice in Data Communications.
8100 McCormick Blvd., Skokie, Illinois 60076.

Programmers! Integrate Instant Graphs™ Into Your Software

Everything's Invisible But Your Profits

Graph-in-the-Box™ OEM Interface requires only a few hundred bytes of code and comes fully documented.

The world's easiest to use business graphics program can now be fully integrated into your own applications, giving your software the graphics edge. Add instant, full-featured business graphs to every program you develop. Pass us your data via memory or file and we will create, display or print the chart and return to your application. You can control every detail of the chart or we'll do it automatically. Our technical reference manual includes examples in Microsoft's™ Basic™, Pascal™ and C™ plus Borland's Turbo Pascal™.

- Drivers for over 90 printers and plotters including color, laserjet, 24pin, etc.
- 11 chart types, 500 observations, 15 variables
- Invisible to the end user
- Interrupt driven
- Memory resident/128K/removable from memory
- Supports CGA, EGA, Hercules, Tecmar Graphics Boards
- For the IBM PC, XT, AT, 3270 PC, PC Jr, PC Convertible and true compatibles

Development kit $187.60. Includes Graph-in-the-Box diskette, full documentation and technical reference manual. OEM Licenses available.



New England Software, Inc.
OEM Sales Division
Greenwich Office Park 3
Greenwich, CT 06831
(203) 625-0062

Instant Graphs In Virtually Any Application

Registered Trademarks: Microsoft Basic, Microsoft C, Microsoft Pascal, Borland Turbo Pascal, Graph-in-the-Box, Instant Graphs.

fications. "I don't know anything about UNIX or Pascal, but I know the computer you need," came the reply. I was quickly whisked off, set in front of an IBM PC AT, and told "This is it."

Unfortunately, the AT would not boot off the hard disk. After about 15 minutes of trying to boot the thing, and ignoring my suggestion that there was probably no system on the hard disk, the salesperson went off to ask her boss. She promptly and cheerfully returned with a disk that was "just what I needed." It was a "get to know the PC" disk, one of those programs that start off drawing the keyboard on the screen. I had reached my limit and asked to see someone who knew a little bit more about the machine. Her boss came out. Putting my temper firmly on hold, I again asked about the machine's capabilities. After being assured that the machine would do everything I wanted it to (even though he could not answer questions about extended versus expanded memory), I asked about price.

The boss quoted a figure about $500 above what I had said I wanted to spend, but he gave me a 15 percent discount that brought it down. That was just for the hardware! The software (even though they didn't know anything about UNIX—or, more accurately, though I didn't have the heart to tell them, XENIX) was extra, as was the memory configuration I requested, and everything else. They would not even bother to give me a quote on the total system price!

Just about at the end of my tether, I finally said that I would have to think about it, but I would definitely have to see the stuff all together and operating before I plunked down the cash.

"Oh. We don't do that. You have to buy it first," they said. Needless to say, I thanked them and deposited their business cards in the first trashcan I passed after I left the store. I tried three more ComputerLand stores; only two people knew what UNIX was—and *they* didn't know where to get it!

Episode number two was even worse.

My wife and I use our little CP/M computer for just about everything. We want to upgrade to a 68000-based system just because they are new, exciting, cheap, and fun to play with. However, the Mac meets only two of those criteria, so we decided to take a look at the Atari 1040ST. A computer store in our neighborhood sells them, so off I went.

Admittedly, I was in jeans and my hair was a bit windblown, but I wasn't grungy or anything. I walked into the store, sat down in front of a machine, and moved the mouse around. Zoom! Right over my shoulder appeared a pair of polite salespeople. When I asked for a word processor and the system disk, saying I'd like to just "play around for a little while," one of them said "We don't let people touch our disks. Just show me what you want to do and I will do it for you." Now, I don't let strange people touch my disks either (especially if it's not write-protected), but I very politely explained that I wanted to do it myself. I offered to buy any software or disks I damaged in the process and promised not to touch or examine any data disks.

No good. I was not supposed to touch the disks. After ComputerLand, this was too much. I got up, thanked them, and headed for the door. They said some rude things to me on my way out, and I was rude right back.

The only places where I have been treated with courtesy and respect are Radio Shack and a small mall-oriented computer shop called the Electronic Boutique. Unfailing politeness and a willingness to dig out the answers have been the rule there. (Unbelievable, isn't it?)

Well, the whole point of this is, how about writing a column on computer-shopping etiquette? I mean, it seems that the normal rules of politeness do not apply here. There was a time when anyone shopping for a computer was almost always welcome to at least try out the stuff he was shopping for! I don't feel very confident about buying anything from someone so rude. If they are going to be so (the only word I can think of is terrifically impolite), then why should I do business with them? But then I am left with just mail-order suppliers, who are generally very polite and helpful, thank goodness!

Paul Raulerson
Norristown, PA

Stories like yours need telling often. Unfortunately, many (most?) computer store managers don't seem to read BYTE anymore.

Of course, I agree with your stipulation about Pournelle's rule and that finding a good dealer is often as difficult as deciding what computer to buy; indeed, in some cases I'd choose the better dealer, even if he didn't handle the particular machine I wanted.

By the way, from the criteria description in your letter, the machine you want is the AT&T PC 6300 Plus, only make sure you get the largest possible hard disk.—Jerry

Copyrighting Software

Dear Jerry,

In October's Chaos Manor Mail, a reader questioned why the simple copyright notice that appears in books is inadequate protection for software. In

continued

The Magnificent Seven.



Meticulously engineered. Exactly compatible. Incredibly priced. In the three most competitive areas, Tandon's new line of XT and AT compatibles are more than a match for any other models, from anyone. Including IBM®

For greater disk storage capacity and fast access time, few can measure up to our PCA™-40, a 40 megabyte AT compatible micro. And you'll really appreciate the magnificent view from our monitors. They're high on resolution and larger by a wide margin.

What's more, Tandon offers one of the most complete product lines in the industry. Which means we can meet the needs of your business, large or small. And because Tandon's average price is 40% less than equivalent IBM systems, we can lower the cost of your business computing requirements.

All of which proves that for XT and AT compatibles that are reliably designed and affordably priced, your choice is magnificently simple. Tandon.

For your Tandon Fact Pack and the name of a dealer near you call us toll free now on:

800/556-1234 Ext. 171
In California:
800/441-2345 Ext. 171

FREE TANDON FACT PACK

B3/87

Please send me your comprehensive packet of literature and product reviews which proves why Tandon is the magnificent choice.

Name _____
Position _____
Company _____
Address _____
Telephone _____
Nature of Business _____
No. of Employees ☐ No. of Installed PC's ☐

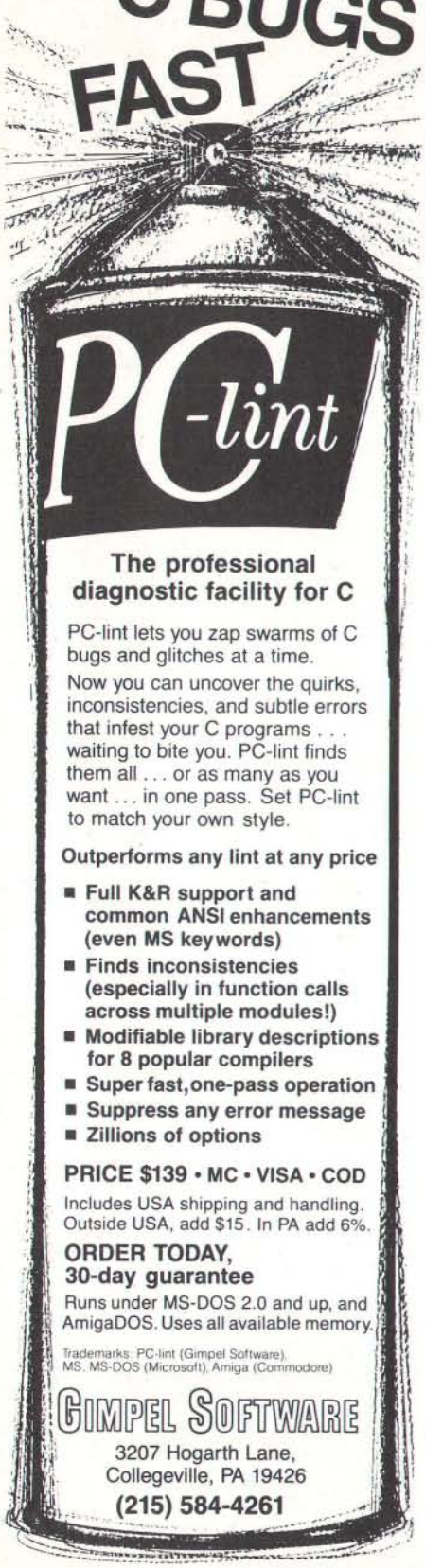
Tandon
Less money. More micros.
405 Science Drive,
Moorpark, CA 93021 805/378-6081

PCX™ and PCA™ are trademarks of Tandon Corporation. IBM® and IBM PC AT® are registered trademarks; IBM PC XT™ is a registered trademark of International Business Machines Corporation. Prices displayed are manufacturer's suggested prices and do not include monitor.

Inquiry 121

#1 Lint for MS-DOS

KILLS C BUGS FAST



The professional diagnostic facility for C

PC-lint lets you zap swarms of C bugs and glitches at a time.

Now you can uncover the quirks, inconsistencies, and subtle errors that infest your C programs . . . waiting to bite you. PC-lint finds them all . . . or as many as you want . . . in one pass. Set PC-lint to match your own style.

Outperforms any lint at any price

- Full K&R support and common ANSI enhancements (even MS keywords)
- Finds inconsistencies (especially in function calls across multiple modules!)
- Modifiable library descriptions for 8 popular compilers
- Super fast, one-pass operation
- Suppress any error message
- Zillions of options

PRICE $139 • MC • VISA • COD

Includes USA shipping and handling. Outside USA, add $15. In PA add 6%.

ORDER TODAY, 30-day guarantee

Runs under MS-DOS 2.0 and up, and AmigaDOS. Uses all available memory.

Trademarks: PC-lint (Gimpel Software). MS. MS-DOS (Microsoft). Amiga (Commodore)

GIMPEL SOFTWARE

3207 Hogarth Lane,
Collegeville, PA 19426

(215) 584-4261

essence, copyright protection prohibits software users from doing three things: copying, distributing copies, and adding enhancements or making new versions. If these were the only three issues with which a software publisher had to be concerned, then I agree that the copyright notice would be sufficient.

However, copyright protection does not prevent a software purchaser from selling, lending, licensing, or leasing his copy to anyone else. It does not prohibit copying the program for backup purposes or using the software at as many locations as the user wishes or with an entire network of machines, and it may not prohibit the user from reverse-engineering the software.

Further, copyright protection does not prohibit a user from bringing a lawsuit for damages he believes resulted from use of the software. Lotus Development Corp. has been sued in Florida by a construction company, which alleges that a latent defect in Lotus's Symphony program caused it to lose $250,000 in a construction bid. Other potential examples include liability of software developers for errors in computerized medical diagnostic techniques, architectural programs, elevator control programs, tax preparation programs, and securities investment advice programs, to name but a few.

It is only through software licenses that software developers can address these issues. If these licenses are invalidated, it is the users who will ultimately bear the price if software developers have to insure against damages resulting from use of their software. Software costs would rise and the small software developer responsible for much of the industry's innovation might find it difficult to survive.

It will take the legislatures and courts many years to define the rights of software users and the extent of software developers' liability. An awareness of the issues by both software developers and users is essential to help shape resolutions.

Lawrence B. Levy
Palo Alto, CA

Well, the Lotus suit was withdrawn. And the one thing that I am certain of is that when all the controversy is over, the lawyers will have made lots of money. But, then, they always do.—Jerry

Drippy Disks

Dear Jerry,

Here is a summary of an article I thought would interest you. It's from "Hanging Your Software Up to Dry" by Nancy B. Olson, published in *College and Research Library News*, November 1986:

A complete run of the software serial SoftDisk was soaked when a waterpipe somewhere overhead broke in the early-morning hours of June 19, 1986, in the Mankato (Minnesota) State University Library. Water not only stood in the envelopes but also got inside the plastic jackets and into the disks and liners themselves.

Disks that were only slightly wet (water didn't spurt out when they were squeezed) were dried with a hair dryer (no heat—blow only) and copied successfully onto new disks.

Dripping disks were peeled out of their jackets when possible and cut out with a paper cutter when necessary. The extracted disks were then wiped off with a rag (thermal underwear!) and hung up to dry. A temporary jacket was made by cutting 1/16 inch off the write-protect edge of a new floppy and removing the blank disk. One at a time, the dried inner disks were inserted and successfully copied to fresh ones.

Joseph E. Ryus
Richmond, CA

Thanks for that story! The picture of the little round disks hanging up to dry (suspended by lines through the center holes) is hilarious. Glad to know it can be done, but I'd sure hate to have to do it. —Jerry

Not So Easy

Dear Jerry,

I noted your dislike of copy-protected software again, which is why I am writing.

Why isn't it possible to write a transfer program that will bypass all copy-protection schemes? Suppose you transfer one sector at a time?

Read Sector 0000, track 0000, disk 1, and write to memory locations abc&–xyz&

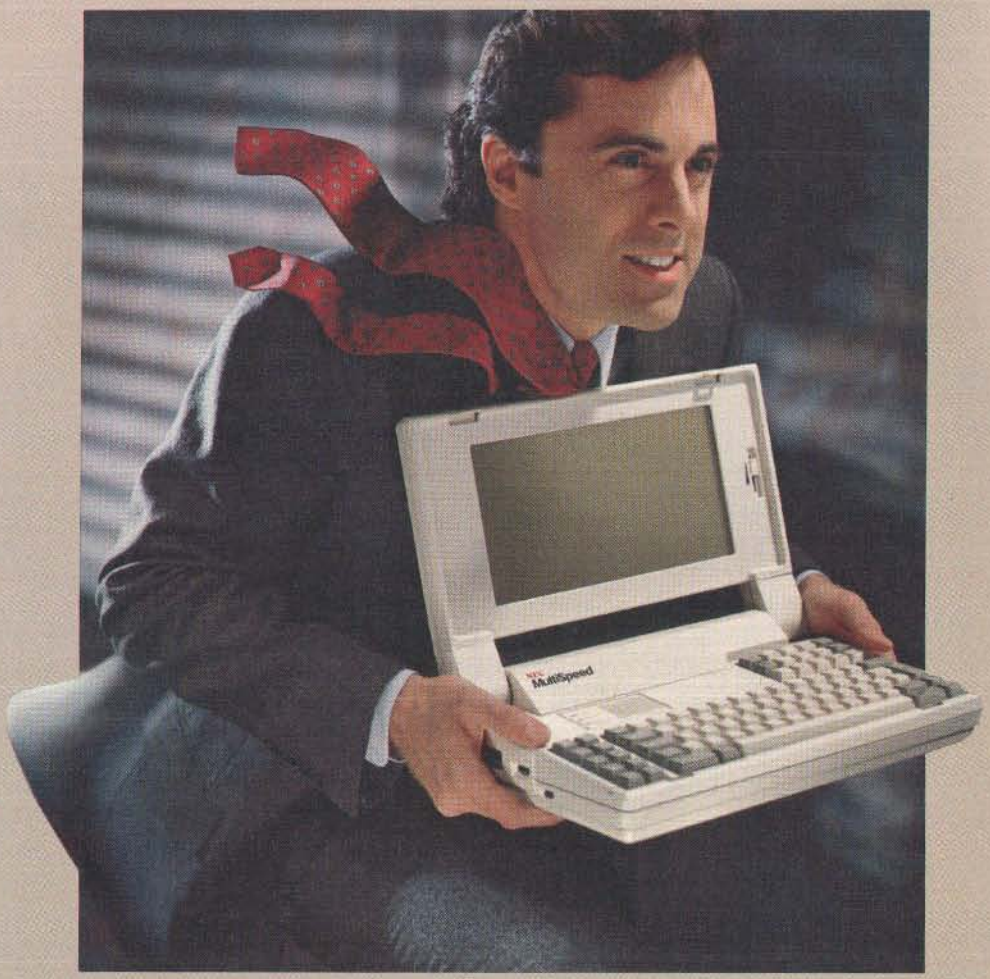
Read memory locations abc&–xyz& and write to sector 0000, track 0000, disk 2

With the use of incrementing, one could read and write the entire disk, and by using the same memory locations, only one sector is in memory at a time, so the copy-protection scheme never gets a chance to act.

Cecil H. Royce
Chattanooga, TN

Alas, copy-protection schemes do things like mislabel disk sectors, reformat the disk by putting data in places it's not supposed to be, and many other odd schemes. One detection method is to burn a hole in the disk, then write to that sector; if it can read back what it wrote, the copy is illegal.—Jerry ■

Take the Multi and run.



NEC introduces MultiSpeed.™ The world's fastest portable computer. It's designed to make you a runaway success.

MultiSpeed is multi-talented. It's small. Light. And gives you the option of running at a clock speed of either 9.54 or 4.77 MHz.

MultiSpeed can do most anything your desktop PC can. It has the most advanced LCD screen technology. So it's easier to read.

What's more, it's PC compatible and even does windows.

And MultiSpeed is a very smart buy. It comes with a bundle of built-in features that cost a bundle on other portables.

Standard Features	
Clock Speed	9.54/4.77 MHz
Memory	640K bytes
Built-in Software	5 programs
Disk Drives	Dual 720K (3.5")
Screen type	Super-twist LCD
Keybd. Compatibility	IBM PC/XT*
Numeric Keypad	Separate
Weight	11.2 lbs.

*IBM PC/XT is a registered trademark of International Business Machines Inc.

In fact, when you discover everything it comes with, you'll be delighted at what it goes for.

So if you're a person who's going places, try the portable that helps you get there ahead of everyone else.

You'll find MultiSpeed at Bell Atlantic Business Center, CompuMat, CompuShop, ComputerLand, Connecting Point and Micro Age. For the location of your nearest dealer call 1-800-447-4700.

If you have any questions or would like technical information call 1-800-NEC-SOFT. Or write NEC Home Electronics, Computer Products Division, 1255 Michael Drive, Wood Dale, IL 60191-1094.

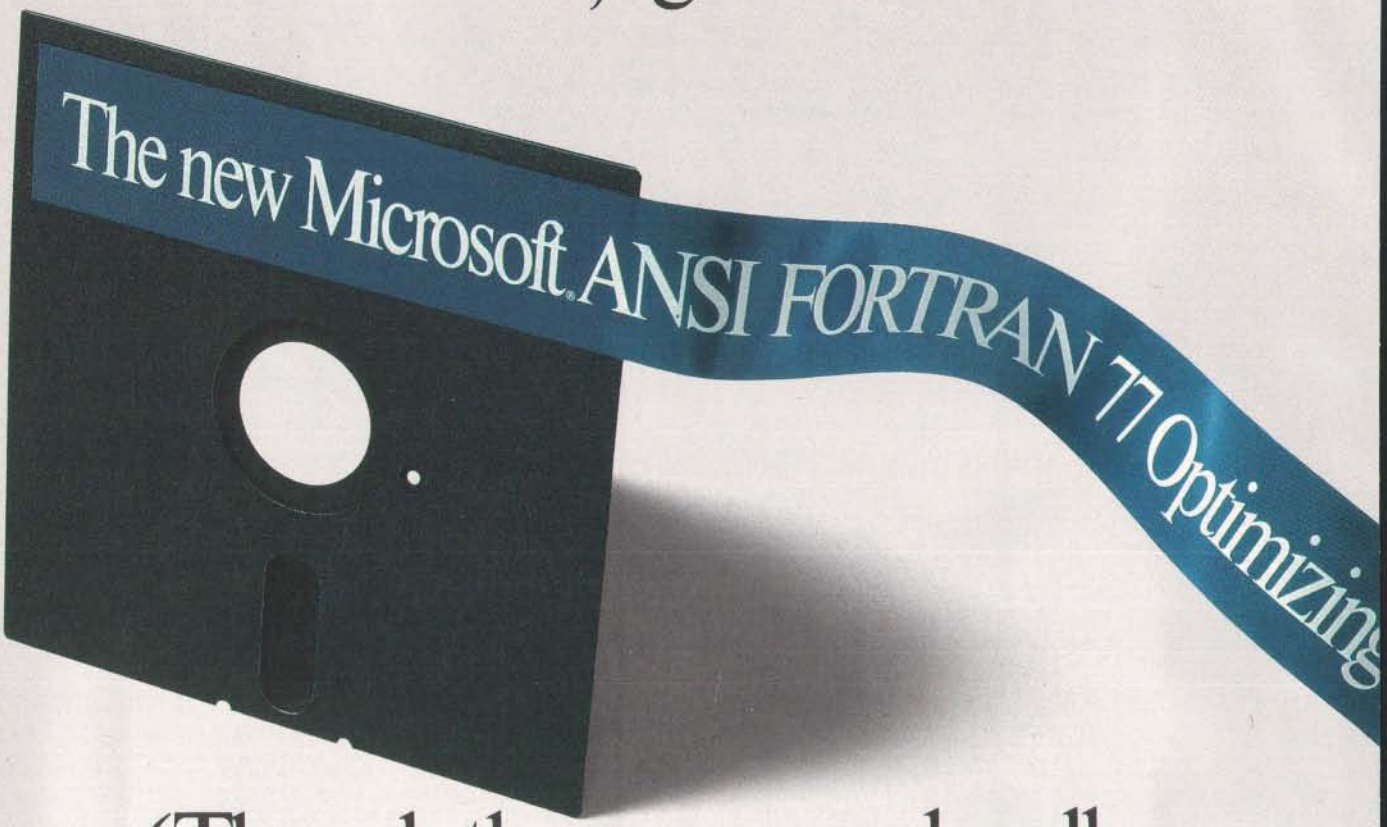
Take the Multi and run.
MultiSpeed™

C&C Computers and Communications

NEC®

Inquiry 206

The fastest, tightest code.



(Though the same can hardly be said of the name.)

We have to tell you, we had a hard time getting the name down this short.

Because Microsoft's new FORTRAN Compiler actually has a far longer list of features.

It uses the same optimizer and code generator technology that made our C Compiler the industry leader.

And we've added special loop optimizations that give you the smallest, fastest FORTRAN code a PC can handle.

> *"Now Microsoft's FORTRAN Optimizing Compiler generates such fast code that an IBM PC/XT approaches the speed of the VAX."*
>
> *Peter Osgood, MIT, Project Athena, Director of the Real Time Lab Project.*

This compiler has already passed the toughest test there is. It's been

Microsoft FORTRAN Optimizing Compiler Version 4.0.

- ♦ Full ANSI FORTRAN 77 Compiler with Fastest Executable Code for MS-DOS. NEW!
- ♦ Uses the Microsoft C optimizing technology, plus loop optimization. NEW!

Execution Speed (in Seconds)	Microsoft FORTRAN v. 4.0	Ryan-McFarland FORTRAN v. 2.11	IBM Professional FORTRAN v. 1.22
Sieve	7.97	9.33	38.51
Whetstone	53.82	58.67	79.04
Lookup	5.82	18.61	26.02

- ♦ Fully GSA certified for ANSI 77 compatibility with no errors at the highest level. NEW!
- ♦ Numerous IBM VS and DEC VAX extensions. NEW!
- ♦ Microsoft CodeView: Window-oriented source-level debugger. NEW!
  - —Debug using your original source code, the resulting disassembly or both intermingled.
  - —Watch and change the values of your local and COMMON variables as you debug.
  - —Set conditional breakpoints on variables, expressions or memory; trace and single step.
  - —Watch and change registers and flags as you execute.
  - —Easily debug graphics oriented programs since program output is kept separate from debugger output.

GSA-certified as Full ANSI FORTRAN 77, and 100% error-free.

"The Microsoft FORTRAN Optimizing Compiler let us port the 200,000 line Boeing Mathematical Library (BCSLIB) with virtually no changes. This ANSI FORTRAN 77 code was ported directly from Cray, CDC, DEC, IBM and other mainframes and workstations."

Ivor Philips, Boeing Computer Services, Program Manager Mathematical Software Libraries.

Compiler V. 4.0 with CodeView™

We've also included the same advanced intrinsic math functions found on VAX® and IBM® VS systems. Add improvements like our new HUGE memory model, and porting the biggest mainframe programs has never been easier.

Among the many additions we've made to our package is our exclusive CodeView™ windowing debugger. It lets you trace through programs at any level you want, from source code to assembly language.

You can open windows, and watch both variables (local and COMMON) and CPU registers change. You can set conditional breakpoints using variables and expressions.

Debugging gets even easier with the compiler's advanced diagnostics. Detailed error messages are thoroughly explained and cross-referenced in our new manuals.

Documentation that has been completely revised and expanded with tons of examples.

If we're talking your language, use one of the numbers below for more details about the Microsoft® ANSI FORTRAN 77 Optimizing Compiler Version 4.0 with CodeView, and the name of your nearest dealer.

(Even if the call's toll-free, it may be a good idea to refer to it as "FORTRAN 4" for short.)

Microsoft® FORTRAN

The High Performance Software.

Call (800) 426-9400. In Washington State or Alaska, (206) 882-8088. In Canada, (416) 673-7638.

Microsoft and MS-DOS are registered trademarks and CodeView is a trademark of Microsoft Corporation. IBM is a registered trademark of International Business Machines Corporation. VAX is a registered trademark of Digital Equipment Corporation.

- Medium, Large and Huge Memory Model Libraries. NEW!
- Mix models with NEAR, FAR and new HUGE pointers.
- Common blocks and arrays greater than 64K.
- Choose from three math libraries and generate in-line 8087/80287 instructions or floating point calls:
  - —floating point emulator (utilizes 8087/80287 if installed)
  - —8087/80287 coprocessor support
  - —alternate math package—extra speed without an 8087/80287
- Link your FORTRAN routines with Microsoft C (v. 4.0 or higher), Microsoft Pascal (v. 3.3 or higher) or Microsoft Macro Assembler.
- Largest number of 3rd party support libraries available.
- Provides more detailed diagnostic error messages (almost twice as many as competitors) and extensive documentation with non-ANSI 77 features highlighted. NEW!
- Proven reliability—tested with over 2.5 million lines of code compiled and executed.
- MS-DOS® network support with file / record locking and sharing.
- Microsoft Program Maintenance Utility rebuilds your applications after your source files have changed. NEW!
- Other utilities including faster overlay linker (links over 1Mbyte object code), library manager, EXE file compression utility, EXE file header utility, MS-DOS environment setting utility and setup utility.

Inquiry 368

Smart plotters for choosy people.

- 4-model lineup of A/B (ANSI), A4/A3 (ISO) format plotters to meet your specific requirements.
- Flat-bed configuration with high-resolution graphic drawing capability.
- Designed for space-saving 60° tilt angle installation.
- Total reliability from the plotter specialists—Roland DG.



XY PLOTTER
DXY-980A
- MAXIMUM PLOTTING AREA: X AXIS 380mm Y AXIS 270mm (X AXIS 14.9" Y AXIS 10.6")
- MAXIMUM PLOTTING SPEED: 230mm/sec. (9.05 in./sec.)
- PEN USED: 8 Pens
- INTERFACE: Parallel (Centronics); Serial (RS-232C)

XY PLOTTER
DXY-880A
- MAXIMUM PLOTTING AREA: X AXIS 380mm Y AXIS 270mm (X AXIS 14.9" Y AXIS 10.6")
- MAXIMUM PLOTTING SPEED: 200mm/sec. (7.9 in./sec.)
- PEN USED: 8 Pens
- INTERFACE: Parallel (Centronics); Serial (RS-232C)

XY PLOTTER
DXY-885
- MAXIMUM PLOTTING AREA: X AXIS 416mm Y AXIS 276mm (X AXIS 16.4" Y AXIS 10.8")
- MAXIMUM PLOTTING SPEED: 300mm/sec. (11.8 in./sec.)
- PEN USED: 8 Pens
- INTERFACE: Parallel (Centronics); Serial (RS-232C)

XY PLOTTER
DXY-990
- MAXIMUM PLOTTING AREA: X AXIS 416mm Y AXIS 276mm (X AXIS 16.4" Y AXIS 10.8")
- MAXIMUM PLOTTING SPEED: 300mm/sec. (11.8 in./sec.)
- PEN USED: 8 Pens
- INTERFACE: Parallel (Centronics); Serial (RS-232C)

Roland DG

ROLAND DG CORPORATION

1006-14 Takaoka-cho, Hamamatsu-shi, Shizuoka-ken 433, Japan
Phone: (0534) 36-8700 Fax: (0534) 37-8271 Telex: 4225070 AMDROL J

INTERNATIONAL DISTRIBUTER

U.S.A.:
Roland Corp US
Phone: (213) 685-5141 Telex: 0674489 RCUS LSA

CANADA:
Roland DG Canada Inc.
Phone: (604) 273-4453 Telex: 4357819 ROL/AMD VCR

AUSTRALIA:
Roland Corporation Australia Pty. Ltd.
Phone: (02) 982 8266 Telex: 27769 ROLAUS AA

BENELUX:
FRANCE:
W.GERMANY:
AUSTRIA:
SWITZERLAND:
Roland DG Europe N.V.
Phone: (014) 58 45 35 Telex: 71046 ROBNL B

ENGLAND:
Roland (U.K.) Ltd.
Phone: (01) 568 4578 Telex: 934470 ROLAND G

SCANDINAVIA:
Roland Scandinavia A/S
Phone: (01) 32 47 22 Telex: 19720 ROLAND DK

NEW ZEALAND:
Roland Corporation (NZ) LTD
Phone: (09) 398-715 Fax: (09) 391-065

■ If the above doesn't cover your inquiries, please contact Roland DG Corporation, Japan.

Inquiry 261

The Best of BIX is a look at a few of the thousands of messages posted on BIX each month. Excerpts this month are taken from the Amiga, Atari ST, IBM PC, Apple II, Macintosh, BASIC, and Pascal conferences. For more information on joining BIX, turn to the advertisement on page 354.

AMIGA

The Amiga window this month begins with the problems faced by someone writing a printer driver. From unknown references to stack allocation problems and type mismatches, the concerns are voiced, met, and dealt with through the efforts of other BIXen. The window closes with a look at circle and ellipse drawing in C.

PRINTER DRIVER PROBLEMS

amiga/hardware #705, from tweiss (Todd Weiss), Tue Dec 9 13:04:06 1986.

This message is to anybody who has (or knows how to write) a printer driver. I have all the code written, assembled, and compiled. I cannot seem to link it correctly, however.

Here's the scoop. I have written and assembled/compiled the following segments:

```
printertag.asm
init.asm
data.c
dospecial.c
render.c
wait.asm
```

as per the documentation (what there is of it) in the RKM and through other sources. If I link them together without the astartup.obj module, I can get it to link with 2 unresolved references: __base and __cxovf (I think). When I do this, the command table is active (I can use escape codes that don't require a dospecial or render code), but anything that requires the code doesn't work. When I use astartup.obj or c.o, I get all sorts of crazy errors. Looking through the RKM, it seems impossible that Commodore's code would have linked either (too many duplicate and missing declarations).

amiga/hardware #706, from afinkel (Andy Finkel, Commodore Business Machines), Tue Dec 9 13:14:10 1986. A comment to message 705.

Actually, we put that in the manual right from our printed source, so I'm almost certain that it links (as long as you add the missing wait.asm module). The __base and __cxovf sound like Lattice constructs. Have you tried supplying 2 ULONGs with the proper names to make it happy? The printer drivers use NO startup, and the printertag.obj file MUST be first. Perhaps we can get someone more familiar with Lattice to comment on _base and _cxovf? Do you have a listing of istartup.asm?

amiga/hardware #707, from tweiss, Tue Dec 9 13:24:46 1986. A comment to message 706.

Thanks for the reply, Andy. (That was fast!) Yes, I did include the wait.asm. I'll try to add 2 ULONGS and I'll let you know what happens. By the way, the documentation is extremely confusing on this issue as one version shows astartup.obj as the first link file and another shows printertag.obj as the first. Is there any chance of getting "authoritative" documentation on the procedure?

amiga/hardware #708, from cmcmanis (Charles McManis, Intel), Tue Dec 9 14:01:03 1986. A comment to message 706.

The -v option to LC2 will disable stack checking and the references to __base and _cxovf.

amiga/hardware #709, from afinkel, Tue Dec 9 14:51:06 1986. A comment to message 707.

Actually, you need to use the -v option on the LC2 pass to disable stack checking. You also need to do this when you spawn "child" tasks. Otherwise, Lattice gets confused. The link order I use (and I'm one of the authors) is:

```
printertag.obj
init.obj
wait.obj
data.obj
dospecial.obj
render.obj
```

This may be viewed as definitive. However, the only thing that really matters is no startup file, and printertag.obj must come first.

(BTW, if you think you've found duplicate symbols in the printer listing, tell me which ones...)

amiga/hardware #710, from tweiss, Tue Dec 9 15:05:41 1986. A comment to message 709.

Declaring the 2 ULONGs didn't do the job. I'll try this. The duplicate symbols are not in the printer listings (at least none that I found). The problem was that when I used astartup.obj (as shown in the RKM), a few symbols (like _sysbase) are defined in both places. Without using the startup, there's no problem with that. Thanks for the info on the -v option. Unfortunately, it's been quite a while since I've done any programming like this (and then it was very little). I'm mostly used to PL/I and Assembler on a VAX, so I figured I'd run into plenty of silly problems on my part.

amiga/hardware #712, from jmeissen (John Meissen, Lattice), Tue Dec 9 17:22:58 1986. A comment to message 709.

That's correct. The compiler generates stack-checking code at the entry point of a function unless you use the -v option of phase-2. The only reasonable way this could be done was to check the contents of A7 against a static data location, and branch to an overflow handler. The static location is in the startup routine, and the handler is in lc.lib. And, BTW, if you forget to use -v when spawning part of your code as a separate task, Lattice doesn't get confused, but your program sure will. The location containing the bottom of the stack is filled in by the startup code. The new task is created some time later and is given a separate stack. However, the stack-checking code still refers to the original static location with the original bottom-of-stack value. IMHO, the best way to handle stack overflow detection is in hardware. I've worked on systems that have stack instructions with overflow detection and the approach seems to be much cleaner. Too bad Motorola didn't think so.

amiga/hardware #713, from afinkel, Tue Dec 9 17:25:50 1986. A comment to message 712.

>And, BTW, if you forget to use -v when spawning part
>of your code as a separate task, Lattice doesn't get
>confused, but your program sure will.

Yes, this is a better way of saying it. I tend to think of (compiler-added) options such as stack-checking as being part of the compiler rather than part of my program. Fuzzy, I know.

amiga/hardware #715, from tweiss, Thu Dec 11 11:50:23 1986. A comment to message 710.

Using the -v switch and no startup module, the driver compiles and links fine. At this point, I don't have

continued

HARDCORE SOFTWARE

Stop fooling around. It's time to get hardcore about software. With Microsoft.

We'll give you all the resources you want. Tens of millions in R&D funding. Along with one of the most elementary tools for thinking— a door, which leads to your own private office. All backed by management that truly *does* speak your language, because they probably helped write it.

We're serious about software design. If you are, too, then apply right now for one of these opportunities.

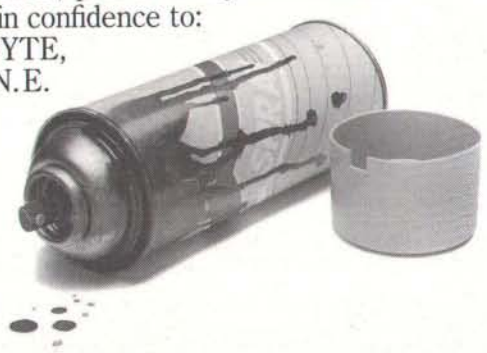
Software Design Engineers

We're working on everything from compilers, operating systems, and networking to sophisticated graphics, powerful productivity software and more. You could be, too, if you have programming experience and a background that includes micro's, "C", 8086, UNIX*/XENIX®, or MS-DOS®.

There are opportunities to work with our teams in systems, applications, or languages.

If you qualify, Microsoft offers you an opportunity to live and work where the quality of life is high and the cost of living is low— the beautiful Pacific Northwest. Along with amenities such as a health club membership, workout facilities and parcourse, plus an array of benefits.

To apply, please send your résumé in confidence to: Human Resources, Dept. HC/SW-0387BYTE, MICROSOFT CORPORATION, 16011 N.E. 36th Way, P.O. Box 97017, Redmond, WA 98073-9717. We are an equal opportunity employer. And no phone calls, please. If we like what we see, we'll call you.



MICROSOFT®

©1987, Microsoft Corporation
*UNIX is a trademark of AT&T Bell Laboratories.
XENIX and MS-DOS are trademarks of Microsoft Corporation.

the manual for my printer (on back order) and have figured out the control codes based on a higher revision of the manual. This works fine, except I can't figure out the codes for graphics dumps.

Having said all of this, I've gotten the command table filled in and the dospecial() routine written. The command table works properly, but the dospecial() routine never seems to be called. I'm stumped! I seem to be doing everything correctly, and all I'm using dospecial for is to modify OutputBuffer and *vline. Still, I can't set tabs or do a printer initialization for this reason.

Any idea of why dospecial might not be called? I'm not so worried about dospecial as I am with render(). If dospecial isn't being accessed, that makes me worry a little bit about render() (when I get it written).

Does anyone have any knowledge as to when, where, and how dospecial is called? Thanks.

---

amiga/hardware #716, from afinkel, Thu Dec 11 12:32:56 1986. A comment to message 715.

Dospecial is called whenever an escape command of the proper form is detected by the printer driver (i.e., someone sends ESC[1m). Dospecial will then either return 0 (to indicate that the command can be found in the data table), a positive number (indicating the number of characters that the ESC sequence translated to), or a negative number (to indicate no characters are to be inserted).

---

amiga/hardware #718, from tweiss, Fri Dec 12 03:33:04 1986. A comment to message 716.

Thanks, Andy. That explains it, as I am automatically returning a 0 from dospecial. One more question: I have since found out that my printer supports 3 densities. Looking through the documentation on the setdensity() function, I have a very hard time figuring out 2 things:

1) Where does the user get to select the density of the print, and
2) How is setdensity() called? It isn't in the ptag for the H-P Plus, and the only mention I see of it is a very vague one in render.c. Unfortunately, my C isn't great, so I'm having a difficult time deciphering the H-P Plus density section.

I'll get this thing together come hell or high water.

By the way, I forgot to ask, but has any documentation been released by C-A regarding drivers in addition to the RKM?

---

amiga/hardware #719, from afinkel, Fri Dec 12 10:10:07 1986. A comment to message 718.

Setdensity is called first thing. You get the parameter (1-4) of density picked from the x parameter of the render call when SPECIAL_DENSITY is set, if the user wants to give a setdensity call via his/her dumprport call. Otherwise, on our printers we pick a default and let the user select another density via the printquality item of Preferences (limit of 2 densities this way).

---

amiga/hardware #720, from tweiss, Fri Dec 12 11:46:45 1986. A comment to message 719.

Thanks, Andy. I have one more (hopefully the last) question. I've gotten the escape codes for graphics dumps and am finishing up render.c. I have also gotten copies of drivers that have been modified by other people. Since they have done it, I know it can be done, but I can't seem to compile it for the following reason: When the compiler gets to something like

```
if (err=(*(PD->PWrite)("x",1))),
```

continued

WE'LL BEAT ANY PRICE



PC/AT SYSTEM 1000
$1359
WITH MONITOR & VIDEO CARD
MONO $1359 / COLOR $1559

- 200W Power Supply/Case
- K-136 AT/XT Keyboard
- 1024K Memory On 80286 Mother Board
- 1.2M High Capacity Floppy Drive
- AT HCD/FDC Controller
- Mono or Color Graphic Adapter
- Assembled and Fully Tested

FREE! UL SURGE PROTECTOR WHEN YOU ORDER NOW

PC/XT SYSTEM 800
$529
WITH MONITOR & VIDEO CARD
MONO $529 / COLOR $739

- Power Supply • Slide Off case
- 640K Expandable Mother Board
- 256K Installed
- K-136 AT/XT Keyboard
- 360K Drive • Floppy Control Card
- Mono or Color Graphic Adapter
- Assembled and Fully Tested



WE'LL DELIVER IT FAST!

MAGITRONIC TECHNOLOGY INC.
9-02 43 ROAD, LONG ISLAND CITY, NY 11101
EAST COAST ORDER
1-800-227-5454
INFO LINE: 718-706-7670
WEST COAST SHIPPING NOW AVAILABLE

All Orders are Shipped UPS COD Cash, Certified Check or Money Order.
IBM® PC/XT are registered trademarks of IBM.

Inquiry 175

I get an error stating that this is a void (error #91 of Lattice V3.03C). I can't see a switch that would allow this, but I know it's been done. What's the secret? (By the way, dospecial is working fine now and I am using the -v switch.)

---

amiga/hardware #721, from afinkel, Fri Dec 12 17:01:37 1986. A comment to message 720.

Check out the typing of PWrite; make sure it is defined as a LONG. Then change the size of err to LONG. I suspect that's it. Also, make sure that render isn't defined as a VOID anywhere.

Green Hills doesn't bother us with these kinds of errors, since it seems to be able to handle them without any problem. I have to lint my code to find these out.

---

amiga/hardware #722, from cscheppner (Carolyn Schneppner, Commodore Business Machines), Fri Dec 12 19:49:48 1986. A comment to message 720.

If you are using 1.1 and 1.1 headers, some of the structures in prtbase.h contain variables declared as pointers to functions such as PWrite, dospecial, and render. They are declared as pointers to VOID functions and this is wrong. Green Hills seems to be really unconcerned about type mismatches, but Lattice is much more picky (I think this is good, BTW). Solution is to change the prtbase.h header so it calls them int or LONG functions. I think this is fixed in the 1.2 headers.

The other type of mismatch problem is caused by the fact that render.c is typed as int on its entry line, but the variable err that it often return()'s is a BYTE. I change "int render(...)" to "LONG render(...)" and "BYTE err" to "LONG err". Seems to work fine. The code receiving the return value (cdumprport in the printer.device) is expecting a 32-bit int, anyway.

SLOW CIRCLES

---

amiga/softw.devlpmt #3063, from mthant (Myo Thant), Sun Nov 16 23:26:15 1986.

Does anyone know why the circle/ellipse routine is so slow? (I'm using Aztec C.) Not only does it draw slowly, but it pauses before it even starts to draw. Does anyone have a fix, or know of a 68000 routine to do the same?

Also, I'm having trouble with the Amiga constantly sending mouse movements to my program. I thought I had all the report flags off. I don't understand it, but whenever I move the mouse my program slows down considerably. Any ideas? Or patches?

And lastly, the Mac has a function to clip both rectangles and ellipses from bitmaps; the Amiga only has rectangles. Any quick-and-dirty ways to do this? (I think I have an idea: Use draw/ellipse into a bitmap and use that bitmap as a mask.) I dunno..... Thanks in advance. J.K.

---

amiga/softw.devlpmt #3064, from rjesup (Randell Jesup), Sun Nov 16 23:38:17 1986. A comment to message 3063.

Ellipses are slow because they take lots of calculation to draw. Recheck your flags. Sounds like REPORTMOUSE or some such is on. Are you using a console device and telling it to report to you? Your idea to draw an ellipse and then use it as a mask is good. Remember, in 1.1 and before there WERE no ellipse routines.

---

amiga/softw.devlpmt #3065, from jdow (Joanne Dow), Sun Nov 16 23:40:23 1986. A comment to message 3064.

The circle draw uses the more general ellipse routine. And the ellipse routine is set up very general. For many specific applications you can do better with custom code. <^_^>

---

amiga/softw.devlpmt #3142, from jim_kent (Jim Kent), Sat Nov 29 18:39:13 1986. A comment to message 3064.

Actually there are ways to draw ellipses with a "stepping" algorithm so that the per-pixel overhead is only slightly more than a line's overhead. You can even do ellipses with axis not along x or y, using stepping algorithms. The end conditions get hairy, though. But anything you do a pixel at a time on a bit-plane machine is going to be fairly slow, even if there's NO calculation involved.

---

amiga/softw.devlpmt #3067, from cheath (Charlie Heath), Mon Nov 17 00:45:45 1986. A comment to message 3063.

What is your program doing? Do you need "real time" control of the mouse, can you sacrifice multitasking compatability during the time when you want very high-speed response?

continued

AC/FORTRAN™ AMIGA

Mainframe quality, full feature **ANSI FORTRAN 77** compiler includes: **Debugger,** Linker, Library Manager, Runtime Library, **IEEE** math, and **C** interface. Supports **Complex** numbers, **Virtual** arrays, **Overlays** and Dynamic Linking. Not copy protected. Available now. $295. Turbo Amiga version also available.

AC/BASIC™

From the authors of **Microsoft BASIC** compiler for Macintosh, comes AC/BASIC for the Amiga. Companion compiler to the **Amiga BASIC** interpreter: has more features and includes a **Debugger,** includes **BLOCK IF, CASE** statement, and **STATIC** keyword extensions and executes up to **50x** faster. AC/BASIC is the new BASIC reference for MC68000 based personal computers. Not copy protected. $295.

ATARI

Telephone orders welcome

absoft

Scientific Engineering Software
4268 N. Woodward, Royal Oak, MI 48072 (313) 549-7111
Amiga trademark of Commodore Amiga
Microsoft trademark of Microsoft Corp.

Inquiry 346

The best diskettes at the best prices!

Don't waste your money on inferior products!
SuperStar™ diskettes are:
HIGH CLIP (65%+)...not ANSI (40%)!
American made...not cheap imports!
Backed by a real LIFETIME WARRANTY!
Yes, you can buy a cheaper diskette...but that's exactly what you'll be getting!

5.25" DISKETTES:	
SSDD	.29 ea.
DSDD	.33 ea.
SSDD-96TPI	.38 ea.
DSDD-96TPI	.46 ea.
DSDD-HD	1.06 ea.
3.5" DISKETTES:	
SSDD	1.06 ea.
DSDD	1.25 ea.

Order in mulptiples of 50 only. $ 35.00 min.
1-800-621-6827
(In Illinois, 1-312-256-7140)
VISA/MASTERCARD ACCEPTED.

DISK WORLD!, Inc.

Inquiry 89

Apparat, Inc. VOLUME BUYER PRICE LIST

LIFETIME WARRANTY
ON APPARAT MANUFACTURED
PC/XT/AT BOARDS - MIX OR MATCH
TO ACHIEVE VOLUME DISCOUNT

Part No.	Description	QTY 10+
7600	Clock/Calendar	$39.00
7602(6)	Eprom Programmer (24 or 28 Pin)	$77.00 ea.
7609	5 Function Combo II	$89.00
7624	64/384K Multifunction	$137.00
7630	64K/2M EMS RAM/Clock	$129.00
7670	256K/1.28M EMS RAM Multifunction	$179.00
7640	64/256K RAM	$53.00
7650	64/512K RAM	$77.00
7664	64/384K RAM/Clock	$89.00
7852	128K/3 MEG AT Combo	$179.00
7860	0 K Piggyback Card (1.5MB) For 7852	$65.00
7870	128K/2MB AT RAM Only	$131.00
7950	Short Slot Parallel/Serial	$59.00

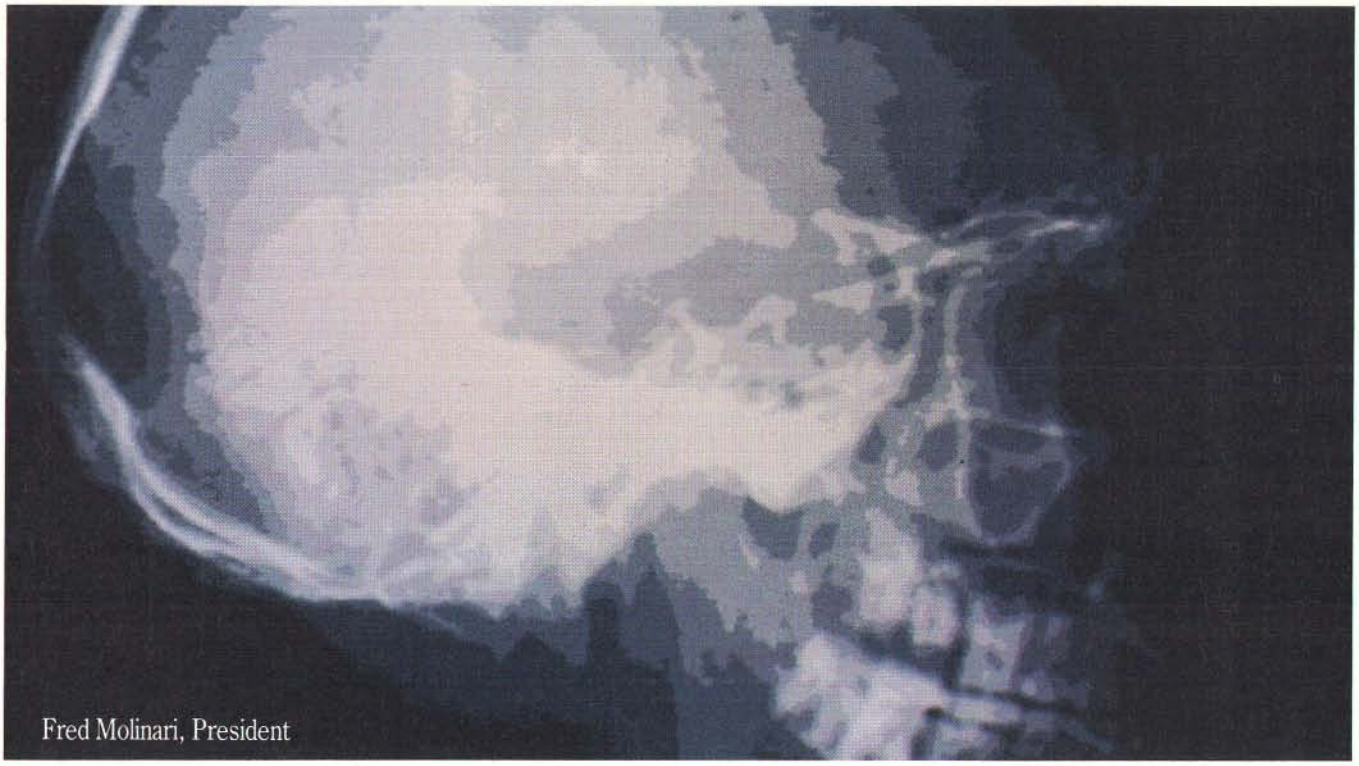
C.O.D. CASH OR CASHIER'S CHECK UNLESS
PREVIOUSLY APPROVED COMPANY CHECK
303-779-0819

ORDER LINE 800-525-7674

APPARAT
6801 S. DAYTON ENGLEWOOD, CO 80112

Inquiry 24

Thinking about Image Processing on an IBM PC? Think Data Translation.



Fred Molinari, President

Are we out of our skull? Data Translation's Image Processing boards and software for the IBM PC, XT, and AT are priced below the competition's, but offer a wider range of functions.

Since Fred Molinari sets prices, we had his head examined. As you can see, Fred and his skull are doing quite well.

And so is Data Translation. We're selling a lot of Image Processing boards and software for PCs, for reasons other than price: • Full-functionality-on-one board • Real-time processing • Different resolutions for different applications • Standard video, VCR, or slow-scan capability • Application and subroutine library software

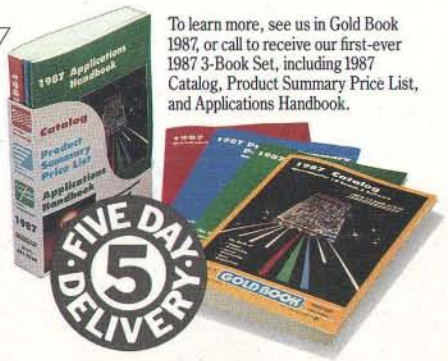
Simply put, Data Translation has the best values on Image Processing boards and software for PCs.

Now, can you think of using anyone else's? If so, may we suggest that you have your head examined?

CALL (617) 481-3700

Image Processing Board	Computer	Spatial Resolution	Gray Levels	RS-170, NTSC, RS-330, CCIR, PAL Compatible	VCR Compatible	Slow-Scan Compatible	Video Inputs	Real-Time Frame Grab	Input and Output LUTs	Memory-Mapped Frame-Store Memory	Real-Time Processing	NxM Conv., Math, Logic Zoom, Pan, Scroll	Software Support	Price ($)
DT2803 Frame Grab	PC, XT, AT	256x 256	64	✓	✓		8*	✓	✓	1 Buffer, 256x256x8 (64 KB)			VIDEOLAB ($995) PC SEMPER ($1495)	1495
DT2851 Frame Grab and DT2858 Frame Proc	PC, AT	512x 512	256	✓	✓	✓	8*	✓	✓	2 Buffers, 512x512x8 (512 KB) and 1 Buffer, 512x512 x 16 (512 KB)	✓	✓	IRIStutor (free) DT-IRIS ($995) PC SEMPER ($1995) DT/Image-Pro ($1495)	2995 1695

*With DT2859 half-size 8-channel multiplexer board.



To learn more, see us in Gold Book 1987, or call to receive our first-ever 1987 3-Book Set, including 1987 Catalog, Product Summary Price List, and Applications Handbook.

Data Translation is a registered trademark of Data Translation, Inc. IBM PC, XT, and AT are registered trademarks of International Business Machines Corp.

DATA TRANSLATION

World Headquarters: Data Translation, Inc., 100 Locke Dr., Marlboro, MA 01752 (617) 481-3700 Tlx 951 646
European Headquarters: Data Translation, Ltd., 13 The Business Centre, Molly Millars Lane, Wokingham Berks, RG112QZ, England Tlx 851849862 (#D)
International Sales Offices: Australia (61) 2-6635289; Belgium (32) 2-7352135; Canada (416) 625-1907; Chile (2) 2-253689; China (408) 727-8222; Denmark (45) (02) 187188; England (44) 734-79383; Finland (358)-90-372144; France (33) 146306839; Greece (30) 951-4944; Hong Kong (852) 3-318585; India (91) 2-231040; Israel (972) 3-324298; Italy (39) 2-81821; Japan (81) 3-502-5550, (81) 3-375-1551; Korea (82) 778-0721-5; Malaysia (60) 3-36299; Morocco (21) 9-30-6949; Netherlands (31) 70996360; New Zealand (61) 2-663-5289; Norway (47) (02) 559050; Peru (51) (14) 31-8060; Philippines (63) 818-0103; Portugal (351) 1545313; Singapore (65) 271-3163; South Africa (27) 12469221; Spain (34) 14558112; Sweden (46) 8-7617820; Switzerland (41) 17231410, (41) 22360830; Taiwan (86) 2-709-1394; (86) 2-531-2434; West Germany (49) 89809020.

amiga/softw.devlpmt #3074, from w.volkaegis (William Volk, Aegis Development, Inc.), Mon Nov 17 16:31:25 1986. A comment to message 3063.

Creating a mask is the more efficient way to do a ClipRegion a la the Mac. The Mac, I gather, has a rather high-powered multipolygon clipper, hence the region stuff.

amiga/softw.devlpmt #3079, from dhubbard (David Hubbard), Tue Nov 18 21:46:16 1986. A comment to message 3063.

Regarding circle generation, there is a good discussion in "Fundamentals of Interactive Computer Graphics" by Foley and Van Dam (Addison-Wesley). Also, check out "Microcomputer Displays, Graphics, and Animation" by Bruce Artwick (of Flight Simulator fame) (Prentice-Hall). A custom routine sounds like best bet.
Dave H.

amiga/softw.devlpmt #3085, from mthant, Wed Nov 19 19:26:51 1986. A comment to message 3063.

I talked to Carolyn at Commodore, and she said the reason everything was so slow was because I had a high-res 4-bitplane screen opened, and that was slowing down Intuition. (Beat that!) Anyway, I got things going at a reasonable rate and I could always close the Workbench screen to speed things up. (Oh boy, here come the cries from those who desire multitasking....) But the fact is I can't spare any bitplanes, so.... By the way cheath, I'm writing a game on the Amiga, a surgery game, and I was displaying an EKG pattern on the screen, which is supposed to be "real time," but as I moved the mouse (to cut into the patient for instance) the EKG slowed down. Too much actually, but now it's a little better. Ideally, I'd like it to be in a separate task, and timed, but I haven't figuired that out yet!

Oh well. As for the masking with the ellipses, that's what I'll do. Right now I'm having sprite troubles. (I can only get one sprite on screen at a time; as soon as I put a second one up, the first one disappears!) I'll fix it.... Thanks. J.K.

amiga/softw.devlpmt #3087, from cheath, Wed Nov 19 19:50:14 1986. A comment to message 3085.

That's tough with 4 bitplanes HIRES. It's okay to close down the Workbench screen if it's done through the Intuition calls and it is reopened when you exit. You can't guarantee it will be closable, though, because there must be no windows open in it except for the WBench windows, else it can't close. However, that's not likely to improve your speed, because the WBench screen doesn't use any extra cycles unless it is being displayed. The only way I can think of to improve speed is to install yourself ahead of Intuition in the input.device, and snarf up the MOUSEMOVE events. You'd need to think through a lot of possibilities to make sure this works safely. For an example, check out how "Grabbit" works. For implementation, the closest thing to an example I know of is popcli, and the chapter on input.device in the RKM.

ATARI ST

The Atari ST section begins with a long thread discussing the disk format used by the ST. Access speed, FATs, and similarities to the IBM PC format are mentioned. The second thread concerns itself with



SEEING THE SOLUTION SHOULD BE EASI

With Truevision® graphics products from AT&T, seeing even the most complex business solutions is no problem.

Truevision gives your PC new powers to capture, display, manipulate, create and duplicate TV-quality images.

Quickly. Simply. And economically.

Start with a Truevision Advanced Raster Graphics Adapter (TARGA) card in your AT&T- or IBM-compatible PC to put real-life images on your screen! Then use our award-winning Truevision Image Processing Software (TIPS) to superimpose text. Change colors. Magnify. Even create original artwork with ease!

Solve your presentation problems with Truevision PictureShow software to show your digitized images right on your PC in an electronic slide show.

Or, use the Truevision Film Printer to produce instant color prints, 35 mm slides, and high color resolution transparencies in minutes, in house.

Truevision is a registered trademark of AT&T. IBM is a registered trademark of International Business Machines Corp.

Suggested retail prices: TARGA 16 ($2995), TARGA 24 ($3995), TARGA 32 ($4995), TIPS ($1250),

reading Shift/Control/Alt keys in conjunction with other keystrokes from within a C program.

ST DISK FORMAT

atari.st/tech #1216, from dmichael (Michael DeCorte), Thu Nov 13 23:51:55 1986.

First, does anyone have some suggestions as to where I can find some accurate information on the disk format for the ST from the software point of view (where and how are the directories and stuff like that - not what are the sector gaps)? I understand the STs have the same format as the IBM; is this right? Second, can the first 2K of the ST be modified? I want to change the BIOS calls. In other words, is the first 2K in ROM? I am going to try a program (might be an accessory) that will change the disk I/O routines so that they do disk buffering. Should speed things up about 5 times so that sequential disk access is on par with the IBM, Amiga, and Mac.

P.S. The name of a book would be just fine for disk format info.

---

atari.st/tech #1217, from sprung (Ron Sprunger), Fri Nov 14 01:27:38 1986. A comment to message 1216.

The directories start on track 1, sector 3 for single-sided, and track 0, sector 3 for double-sided (side 1). Format is the same as IBM, but I don't have the details at hand as to how the offsets are referenced, etc.

As for the first 2K of memory - it's not in ROM, but it IS protected. The details are in the Hitchhiker's Guide (DevPak); the Abacus books probably have it as well. David Small had an excellent article about the controller in the last issue of STart, along with a raw sector-read program. I'm told you can speed it up considerably if you turn off error checking. The drives are not slow, but in sequential reads, they turn off while you process - you might want to just leave them on to speed things up.

---

atari.st/tech #1218, from dmichael, Sun Nov 16 01:40:46 1986. A comment to message 1217.

Thanks for the info. I will look in Hitchhikers. As for the drives not being slow - I did a few tests a while back. I used program loads, a file copy, and data loads as tests. The conclusion that I came to was that the ST reads 1 sector/revolution. That's 512 bytes/sector * 1 sector-read/rev * 5 rev/second = 2560 bytes/second. Not good. On the other hand, assuming 9 sectors/track, you could read 512 * 9 * 5 = 23040 bytes/second. This is the best possible time and is optimistic, but people have increased sequential I/O fivefold using a simple track buffer. It kills almost 5K, but I have a meg here, so 5K won't kill me.

---

atari.st/tech #1221, from sprung, Sun Nov 16 13:10:05 1986. A comment to message 1218.

>1 sector per revolution...

I hope that's on a badly churned disk; that is, where the sectors have been really spread around. For track reads, the XBIOS routine FloppyRead is easy, but make sure you have the updated version from listings and, of course, you'll have to figure from the directory just what it is you want to read. I use it for disk copies, and they go fast enough. If you really want to change the BIOS, I wonder if Dave Small's approach would serve. In The Amazing MouseTrap, he installs and stays resident, but changes the trap-14 vector to himself, so

continued



THAN UNDERSTANDING THE PROBLEM

Finally, catalog the images on your PC for convenient, efficient retrieval with Truevision PicturePower Database Management Software.

Pictures that communicate are serious business. So when you're serious about seeing solutions, talk with Truevision.

We're changing the way personal computers see things.

AT&T Electronic Photography and Imaging Center. 7351 Shadeland Station, Indianapolis, IN 46256. **1-800-858-TRUE.**

Display shows actual, unretouched image.

AT&T

Truevision design and development by: RADAKAKACCCEJHDHJHBHDJCMGMBPLRASJSJSBSJW. © AT&T 1987.
PictureShow ($150), PicturePower ($945), Truevision Film Printer ($2995).

Inquiry 30

that he can intercept and act on right button clicks, but pass all else through to TOS. (Hope I didn't mangle that too badly.)

---

atari.st/tech #1273, from dmichael, Sat Nov 22 01:47:57 1986. A comment to message 1221.

1 sector per rev. That's the timing I got for file transfers and program loads. About changing the trap - you read my mind.

---

atari.st/tech #1222, from dsmall (David Small), Sun Nov 16 15:44:44 1986. A comment to message 1218.

The problem with track buffering is going track to track. Atari uses a seek-with-verify that manages to miss the first sector of the next track on chained reads; hence, you always lose one rotation. TOS adds a fierce amount of overhead.

---

atari.st/tech #1303, from ianl (Ian Lapore), Thu Nov 27 02:43:07 1986. A comment to message 1222.

I hope everyone is familiar with the formatting utilities that correct this seek-with-verify timing problem. I first ran across it in Analog, in the form of a program called FORMAT PLUS. This BASIC program requires TOS in RAM. It changes the BIOS format routine such that subsequent disk formatting results in a different track layout.

I started analyzing the track format it creates, in hopes of writing a C program to do the format... primarily to eliminate the need for a RAM TOS. Several beat me to it (QFORMAT.PRG, et al.). What I did determine was that the number of slack bytes between sectors was reduced slightly, and the resulting extra room was used to add a "dummy" sector or two to the end of the track. This (apparently) provides time for a seek-with-verify to happen without the start of track marker flying by, and the resulting 1-rev wait for it to come around again.

Using disks in this format, and turning off the write-verify switch, truly DOUBLES floppy I/O rates. (As long as track-sized reads/writes are being done.) The track format is still 9 sectors per, with no interleaving. As far as the BIOS/XBIOS/GEMDOS routines are concerned, it is a standard format disk. If need be, I can upload a couple of the programs that do this formatting. I swear by this. I couldn't go back to the standard format disks and still get any work done.

---

atari.st/tech #1219, from jtittsler (Jim Tittsler, Atari Corp.), Sun Nov 16 12:42:38 1986. A comment to message 1216.

The best source of information about the ST disk format is to use the Hitchhiker's Guide to the BIOS in conjunction with your favorite MS-DOS document (I might suggest one of Peter Norton's books like "Inside the IBM PC," but I won't). The Guide will explain the layout of the boot sector, including the prototype BPB. The MS-DOS reference should fill you in on how to interpret that in terms of FATs and directory space.

---

atari.st/tech #1272, from dmichael, Sat Nov 22 01:45:33 1986. A comment to message 1219.

Thanks for the book name. It should contain the info that I am looking for. Hitchhiker's is fine if you know how the FATs and directory are interpeted, but not very good if you don't.

---

atari.st/tech #1274, from sprung, Sat Nov 22 01:50:45 1986. A comment to message 1272.

Yes, I had to do some FAT stuff today, and found the Norton book ideal for the purpose. It doesn't necessarily tell you exactly where everything is, but it gets you close enough that you can find it with a sector dump. It's the first time I ever understood how FATs work; now I can actually find a file or directory reliably with sector dumps.

---

atari.st/tech #1220, from jtittsler, Sun Nov 16 12:44:57 1986. A comment to message 1216.

No, the first 2K of the ST are only accessible when the 68000 is in supervisor mode. (The physical reset vector comes from the first 8 bytes of ROM.) Software can enter supervisor mode and modify the "system RAM."

---

atari.st/tech #1302, from ianl, Thu Nov 27 02:41:17 1986. A comment to message 1216.

About disk buffering...I did a _little_ work on this a while back. I'll toss out what I learned.

You want to hook into the hdv_rw vector (at $476). Even though it's not documented as such, it seems that ALL sector-oriented reads/writes go through here, even the floppies. Resist the temptation to hook the TRAP 13/14 handler to catch floprd/flopwr calls. It's a pain in the neck.

The application I was working on was write-through caching for either floppy or hard drives. I was working it such that the writes went into cache, then were passed along to the regular handler (the old value in the vector). A read would be checked against the cache map. If I could return ALL the sectors requested, I handled it, and the regular handler never saw the call. Otherwise, I would count the accesses to the sector(s), and when the counter got to a certain value, that sector would be cached. Unfortunately, this never got finished, due to problems sensing and dealing with media changes on the floppies. (Actually, I can SENSE a media change okay, I just can't seem to clear it afterwards. The work proceeds...slowly).
Anyway, I hope this helps.

STATUS OF SHIFT/CONTROL/ALT KEYS

---

atari.st/tech #1254, from dbetz (David Betz, Senior Editor, BIX), Fri Nov 21 10:21:25 1986.

How do I determine if one of the Shift/Control/Alt keys was pressed along with a keystroke fetched with bconin()? The getshift() function tells me the current state of the modifier keys, but since the ST buffers keystrokes, it is possible that the current state does not correspond to the state at the time of the actual keystroke.

---

atari.st/tech #1255, from sprung, Fri Nov 21 11:21:58 1986. A comment to message 1254.

According to Hitchhiker's Guide, "If bit 3 in the system variable 'conterm' is set, then the high byte of the upper word will contain the value of the system variable 'kbshift' for that keystroke. [The default state for 'conterm' is OFF.]" Conterm is at $484.

---

atari.st/tech #1260, from dbetz, Fri Nov 21 11:41:24 1986. A comment to message 1255.

Thanks! That's just what I needed to hear.

---

atari.st/tech #1261, from jim_kent (Jim Kent), Fri Nov 21 14:45:56 1986. A comment to message 1260.

Try looking at the high word that cconin() returns normally. Don't think you need to check the system variable. It will be 0 if nothing fancy is pressed, otherwise the high word will tell you about arrow keys, Alt keys, and other good non-ASCII stuff.

---

atari.st/tech #1291, from mpack (Don Milne), Wed Nov 26 12:51:40 1986. A comment to message 1261.

Jim, I don't think that conin returns when only the Alt key is pressed, and if you press any other key, the high word contains only the scan code (not modified by Alt). So if you want to interpret the key differently when Alt is active, you are still left with the problem

continued

Here's how $25 can ease you into the world of expert system development.



Texas Instruments would like you to prove for yourself the simplicity and capabilities of our Personal Consultant™ Series of expert system development tools.

The Personal Consultant Series—get started and keep going.

This Demonstration Package will introduce you to the Personal Consultant family of compatible expert system development tools. As the lowest priced member of the family, Personal Consultant *Easy* is designed to get you started immediately in learning about and creating medium-scale expert systems for use on standard personal computers. The more advanced Personal Consultant *Plus* lets you expand your expert system with the additional features and capabilities needed to create larger, more complex applications for AT-class personal computers.

The Personal Consultant Series—proven performance, practicality, and support.

Personal Consultant products have been helping thousands of people just like you build practical applications of expert systems on TI, IBM,® and compatible personal computers since 1984. And, to support you, we provide the proven performance of these development tools, low-cost application delivery, hotline support, a range of training programs, and knowledge engineering services to help your company get started or expand existing programs.

See for yourself. You can experience a hands-on demonstration for only $25.

Our easy-to-use Personal Consultant demo will let you:

- Interact with an actual expert system application.
- Modify this application by adding additional knowledge.
- Develop and save your own 10-rule system to show your colleagues.

Get started today! To order your Demonstration Package, or for more information, call toll-free:

1-800-531-6789

VISA and MasterCard are accepted.

TEXAS INSTRUMENTS

Personal Consultant is a trademark of Texas Instruments Incorporated.
IBM is a registered trademark of International Business Machines Corporation.
© 1987 TI

261765-04B

NRI Trains You At Home—As You Build Your Own IBM PC Compatible Computer

GET THE KNOW-HOW TO SERVICE EVERY COMPUTER ON THIS PAGE... AND MORE!



Learn the Basics the NRI Way—and Earn Good Money Troubleshooting Any Brand of Computer

The biggest growth in jobs between now and 1995, according to Department of Labor estimates, will occur in the computer service and repair business, where demand for trained technicians will actually *double*.

You can cash in on this opportunity—either as a full-time corporate technician or an independent service-person—once you've learned all the basics of computers the NRI way. NRI's practical combination of "reason-why" theory and "hands-on" building skills starts you with the fundamentals of electronics, then guides you through advanced electronic circuitry and on into computer electronics. You also learn to program in BASIC and machine language, the essential languages for troubleshooting and repair.

Total Computer Systems Training, Only From NRI

No computer stands alone . . . it's part of a total system. To really service computers, you have to understand computer *systems*. And only NRI includes a powerful computer system as part of your training, centered around the new, fully IBM PC compatible Sanyo 880 Series computer.

IBM is a Registered Trademark of IBM Corporati
Epson is a Registered Trademark of Epson America,
Apple and the Apple logo are Registered Trademarks of A
Computer, Inc.
Compaq is a Registered Trademark of COMPAQ Computer Corpo
©1985 AT&T Technologies, Inc.

NEW!

Train with the newest Sanyo 880 Series Computer–it's fully IBM-compatible and runs almost twice as fast as the IBM PC!



You start with the step-by-step assembly of the new, highly-rated, Sanyo computer. You install and troubleshoot the "intelligent" keyboard. Then you assemble the power supply, install the disk drive, and add extra memory to give you a powerful 256K RAM system. The new 880 computer has two operating speeds: standard IBM speed of 4.77 MHz and a remarkable turbo speed of 8 MHz, making it almost twice as fast as the IBM PC. Next, you'll interface the high-resolution monitor and begin to use the valuable software also included with your complete computer system.

It all adds up to confidence-building, real-world experience that includes training in programming, circuit design, and peripheral maintenance. You'll be learning about, working with, servicing, and troubleshooting an entire computer system—monitor, keyboard, computer, disk drive, power supply—to ensure that you have all the essential skills you need to succeed as a professional computer service technician.



Your NRI total systems training includes:
• NRI Discovery Lab® to design and modify circuits • Your four-function, digital multimeter with walk-you-through instructions on audio tape • Digital logic probe for visual examination of keyboard circuits • The newest Sanyo 880 Series Computer with "intelligent" keyboard and 360K double-density, double-sided disk drive • High resolution monochrome monitor • 8K ROM, 256K RAM • Bundled software including GW BASIC, MS-DOS, WordStar, CalcStar • Reference manuals, schematics, and bite-size lessons.

No Experience Needed, NRI Builds It In

This is the kind of practical, hands-on experience that makes you uniquely prepared, with the skills and confidence you need for success. You learn at your own convenience in your own home. No classroom pressures, no night school, no need to quit your present job until you're ready to make your move. Your training is backed by your personal NRI instructor and the NRI technical staff, ready to answer your questions and help you when you need it. You get it all with NRI at-home training.

100-Page Free Catalog Tells More

Send the postage-paid reply card today for NRI's big, 100-page, color catalog on NRI's electronics training, which gives you all the facts about NRI courses in Microcomputers, Robotics, Data Communications, TV/Audio/Video Servicing, and other growing, high-tech career fields. If the reply card is missing, write to the address below.

SEND COUPON TODAY FOR FREE NRI CATALOG!

NRI SCHOOLS
McGraw-Hill Continuing Education Center
3939 Wisconsin Avenue, NW, Washington, DC 20016
We'll give you tomorrow.

For Career courses approved under GI Bill ☐ check for details.

☑ **CHECK ONE FREE CATALOG ONLY**

- ☐ **Computer Electronics**
- ☐ TV/Audio/Video Servicing
- ☐ Satellite Electronics
- ☐ Robotics & Industrial Control
- ☐ Industrial Electronics
- ☐ Telephone Servicing
- ☐ Digital Electronics Servicing
- ☐ Basic Electronics
- ☐ Electricians
- ☐ Small Engine Repair
- ☐ Air Conditioning, Heating, & Ref.
- ☐ Locksmithing & Electronic Security
- ☐ Photography
- ☐ Bookkeeping & Accounting

Name (Please print) Age

Street

City/State/Zip

Accredited by the National Home Study Council 170-037

AT LAST: Professional Typesetting Capability For PC Users

With **PC TEX**™ — the best-selling full implementation of Professor Don Knuth's revolutionary typesetting program TEX.

FINEST Typeset Quality Printing From:
dot matrix laser phototypesetter

$$\sum_{i=1}^{\infty} \frac{1}{i} \qquad \begin{pmatrix} a_{11} & \cdots & a_{1n} \\ a_{21} & \cdots & a_{2n} \\ \vdots & \ddots & \vdots \\ a_{m1} & \cdots & a_{mn} \end{pmatrix} \qquad \int_{-\infty}^{\infty} e^{-x^2}\,dx$$

WIDEST Range Of Output Device Drivers:

- Epson FX, LQ
- Toshiba
- Corona LP-300*
- HP LaserJet*
- Apple LaserWriter
- APS-5 phototypesetter
- Screen preview, with EGA or Hercules card

MOST COMPLETE Product Offering:

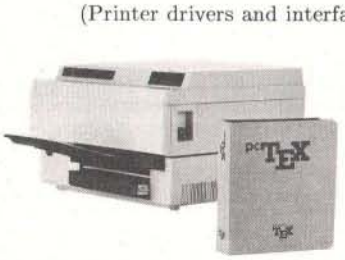
PC TEX (not copy protected) includes the following:

- Our specially written *PC TEX Manual*, which enables you to start using TEX right away.
- Custom "macro packages" that provide formats for letters, manuals, technical documents, etc.
- The LATEX document preparation system, a full-featured macro package for preparing articles, books, reports, etc., and LATEX User's Manual.
- $\mathcal{A}_{\mathcal{M}}\mathcal{S}$-TEX, developed by the *Amer. Math. Society* for professional mathematical typesetting.

Site licenses, volume discounts, and interfaces to PC Paintbrush, PC Palette, FancyFont and Fontrix are also available.

PRICED FROM ONLY $249.00!

(Printer drivers and interfaces additional.)



Laser printer, fonts & software from $2995.00

For IBM PC/XT, AT or compatible, DOS 2.0 or higher, and 512K RAM. Hard disk required for printer drivers and fonts. *HP LaserJet and Corona require additional interface boards.

For more information call or write:

Personal TEX, Inc.

12 Madrona Avenue, Mill Valley, CA 94941 (415) 388-8853

This ad, with space for the photograph, produced by PC TEX. Typeset on the Epson FX80, the Corona LP-300 laser printer, and the Autologic APS-5 phototypesetter.

TEX is a trademark of the American Mathematical Society. Manufacturers' product names are trademarks of individual manufacturers.

of detecting Alt at the time the key is pressed. Ron's solution should handle this easily.

---

atari.st/tech #1295, from neilharris (Neil Harris, Atari Corp.), Wed Nov 26 13:13:15 1986. A comment to message 1291.

You can use the BIOS function 11 (kbshift) to read only the shift status. This function returns the following codes:

Bit	Meaning
0	Right shift key
1	Left shift key
2	Control key
3	Alternate key
4	Caps Lock on
5	Right mouse button
6	Left mouse button
7	unused

---

atari.st/tech #1298, from hisoft (Andy Pennell, HiSoft), Wed Nov 26 13:42:55 1986. A comment to message 1295.

Kbshift (BIOS call 11) will *not* return the mouse buttons as documented, though the keyboard bits do work. The BIOS routine reads a system variable at $e1b, but, sadly, this has nothing to do with the mouse. Another "feature" of Hitchhiker's I guess.

---

atari.st/tech #1306, from jtittsler, Fri Nov 28 12:31:44 1986. A comment to message 1298.

Actually, what the kbshift BIOS call is documented as doing in the Hitchhiker's Guide IS correct, but open to misinterpretation, admittedly. It says

```
0  Right shift key
1  Left shift key
2  Control key
3  Alt key
4  Caps Lock
5  Right mouse button (CLR HOME)
6  Left mouse button (INSERT)
7  (reserved)
```

What bits 5 and 6 are used for is returning the state of the keyboard mouse button equivalents, Alt/Clr Home and Alt/Insert, not the physical mouse button states. The other thing that might need clarification is that the Caps Lock bit indicates the current state of Caps Lock as if it were implemented with a locking push-button; rather than indicating the switch is closed, it will toggle with each Caps Lock keypress.

---

atari.st/tech #1289, from mpack, Wed Nov 26 12:50:16 1986. A comment to message 1255.

>bit 3 in "conterm" forces return of kbshift states...

Thanks, Ron. I have a use for that information myself. I wonder why it defaults to off? Is there some disadvantage to having it returned all the time?

---

atari.st/tech #1309, from sprung, Sun Nov 30 00:15:04 1986. A comment to message 1289.

I don't know, but it seems a pain to have to go supervisor just to tell the machine you want all the keyboard info, doesn't it?

---

atari.st/tech #1312, from dbetz, Sun Nov 30 09:14:30 1986. A comment to message 1309.

I have run into problems with some programs if I leave bit 3 on. They seem to think that they are going to get a value from 0 to 255 from the high word of bconin() and crash when they try to use the full value with the shift bits as an index into a table.

continued



EVERYTHING THE C PROGRAMMER NEEDS

Eco-C88 C Compiler:

A full, professional C compiler with many ANSI enhancements at an unbelievably low price.

* Prototyping, enum, void data types, plus structure passing & assignment * All operators and data types * Over 200 library functions * cc and mini-make for easy use * 8087 support * ASM or OBJ output * Lint-like tiered error messages * Fast code * CED editor (edit-compile-link from within the editor) * Expanded user's manual * Not copy protected * All for only $59.95!

Eco-C88 Flexi-Graph Graphics Package

Everything you need to write dramatic graphics effects into your Eco-C88 C programs.

* EGA, CGA, and Z100 support * Over 100 graphics functions (many are PLOT-10 compatible) * Most assembler support routines are outside small model code-data * Write thru BIOS (for compatibility) or to memory (for speed) * Graphics function help from CED editor * World, pixel or turtle color graphics modes * 47 standard fill patterns, 17 line dashing patterns, Hershey fonts, plus user defineable fill, dash, and fonts * Supports view areas, rotateable fonts, clipping, arbitrary fill areas, extensive error checking, examples, and user's manual * Only $39.95

Eco-C88 Windowing Library

Use this library to build pop-up windows, help windows, selection menus, special effects—anywhere you need an attention getter.

* CGA and EGA support * Control any program that goes through the BIOS * Use up to 255 windows * No special window commands — use plain old printf( ) to write to a window * Resize and move windows * Custom window titles and borders * Can be used with ANSI device driver * Most window code-data are outside small model * User's manual and examples for only $29.95

Ecosoft Librarian

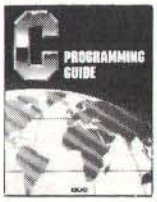
Combine your modules, functions, and subroutines into your own library for easy link commands. Compatible with any standard MSDOS OBJ files * Add, delete, and extract from a library * Get table of contents or index of a library * Combine libraries, control library page size, use switches for combinations, process complex library requests, use wildcards, and do library directives from command files * Complete with user's manual for only $29.95

Developer's Library

Contains the source code for for all library functions, including the transcedentals, memfiles, and those written in assembler. $25.00 with order, $50.00 if ordered later. (Sold only to Eco-C88 owners.)

Ecosoft Inc.
6413 N. College Ave.
Indianapolis, IN 46220

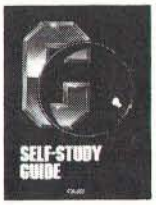
Eco-C88 C compiler requires an IBM PC, XT, or AT (or compatible) with 256K of memory, 2 disk drives and MSDOS 2.1 or later.



C Programming Guide

(Purdum, Que Corp.)

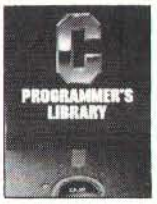
The second edition of the B. Dalton bestseller. Perfect for those just getting started with C. Includes discussion of many X3J11 ANSI Standards Committee recommendations. Many error messages from Eco-C88 give page references to this book. Price is $20.00 plus $2.00 shipping.



C Self-Study Guide

(Purdum, Que Corp.)

Using a question-answer approach, this book is filled with shortcuts, tips, techniques, and traps to avoid when learning C. Price is $17.00 plus $2.00 for shipping.



C Programmer's Library

(Purdum, Leslie, Stegemoller, Que Corp.)

Another B. Dalton bestseller. An intermediate C text for the programmer that wants to get the most from the language. Contains source code for many functions including an ISAM file handler. Price is $22.00 plus $2.00 for shipping.

To order, call or write:

1-800-952-0472 (for orders) or **1-317-255-6476** (tech. info.)

ORDER FORM CLIP & MAIL TO:
Ecosoft Inc., 6413 N. College Ave., Indianapolis, IN 46220

- ☐ Eco-C88 C Compiler $59.95 _____
- ☐ Eco-C88 Flexi-Graph Graphics Package $39.95 _____
- ☐ Eco-C88 Windowing Library $29.95 _____
- ☐ Ecosoft Librarian $29.95 _____
- ☐ Developer's Library $25.00 ($50.00 if not with order) _____
- ☐ C Programming Guide $20.00 _____
- ☐ C Self-Study Guide $17.00 _____
- ☐ C Programmer's Library $22.00 _____

SHIPPING _____ $4.00

TOTAL (IND. RES. ADD 5% TAX) _____

PAYMENT: ☐ VISA ☐ MC ☐ AE ☐ CHECK

CARD# _____ EXPIR. DATE _____

NAME _____

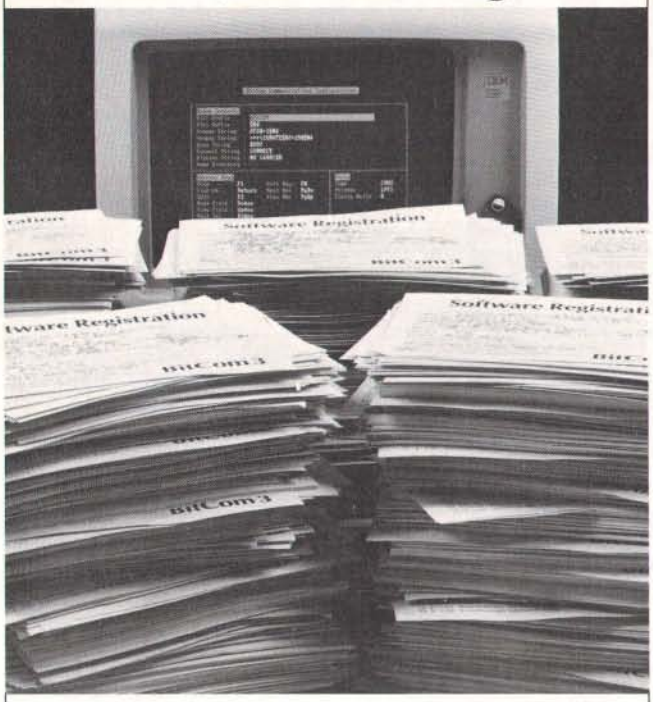
ADDRESS _____

CITY _____ STATE _____

ZIP _____ PHONE _____

ECOSOFT

When 200,000 users like BitCom, it must be good.



Whether you need to dial to on-line services or mainframe communications, don't buy communications software until you've checked out BitCom 3.02. It's the program that thousands of users prefer because it gives you so many features for such a low price:

- Powerful script language with more than 80 functions.
- Supports 132 column by 44 row and 132 column by 25 row (with graphics card).
- Transfers multiple files using YMODEM batch, and supports the popular XMODEM CRC method.
- Auto speed change to match that of remote computer.
- Supports COM1 through COM4.
- Programmable terminal emulation including VT100, IBM 3101 and most ASCII terminals.
- 110 to 9600 baud range.

"AMONG INEXPENSIVE COMMUNICATIONS PROGRAMS,(BITCOM IS) A CHAMP... IT MIGHT EVEN KNOCK SOME OF THE BIG BOYS OUT OF THE RING."

-- PC WORLD

Only $69.00 Not Copy Protected.

Order Today, Call
(408) 263-2197
BIT Software, Inc.
755 Ames Ave., Milpitas, CA 95035

BitCom 3

©BIT Software, Inc. 1987 BitCom is a Trademark of Bit Software, Inc.

IBM PC and Compatibles

The IBM PC section begins with a question of how to prevent a format. Specifically, someone wants to make it more difficult to accidentally format the hard drive. A number of suggestions making use of .BAT files are given. The section ends with a look at the uses and interrupt codes for a variety of COM ports, whether standard or not.

TO CATCH A FORMAT

ibm.pc/software #1839, from dnicol (David Nicol), Tue Dec 2 15:38:22 1986.

I am having trouble with DOS 3.2. I started to write a program, FORMAT.BAT, to catch any attempt to reformat the hard disk (Okay - I have since heard that DOS 3.2 warns you). But I keep getting error messages about intermediate file error. If you are really unlucky, the keyboard can seize up entirely - all you can do is switch off. The .BAT file was something like

```
REM  hard disk saver
if X%1 == XA goto |ok
echo silly trying to format hard disk
goto exit
:ok format %1 %2 %3 %4 %5
:exit
```

Now, trying to trace down the error I find that without any TSRs loaded or anything (DOS is not happy about secondary command processors), COMMAND on its own will enter a new process - but COMMAND DIR to run DIR at the next level falls over with SPECIFIED COMMAND search directory not loaded. This is not what the DOS book says. What am I doing that's silly? It's a standard AT with a PGC card. I had CED loaded, but even without that, and with no other TSRs, I am still running into trouble.

---

ibm.pc/software #1840, from jrobie (Jonathan Robie), Tue Dec 2 16:29:15 1986. A comment to message 1839.

I'm not sure what your problem is, but I wrote a program to do the same thing months ago and left it in ms.dos/batch as message #108. It works on my computer under DOS 3.2. Hope it does the job for you!

---

ms.dos/batch #108, from jrobie, Mon Aug 4 23:12:01 1986.

I have a good friend who just formatted his hard disk. Since I'm the person who has to bail him out when he does these things, I thought I'd write a batch file to protect him.

This batch file expects a format statement in the formt a: /s/v

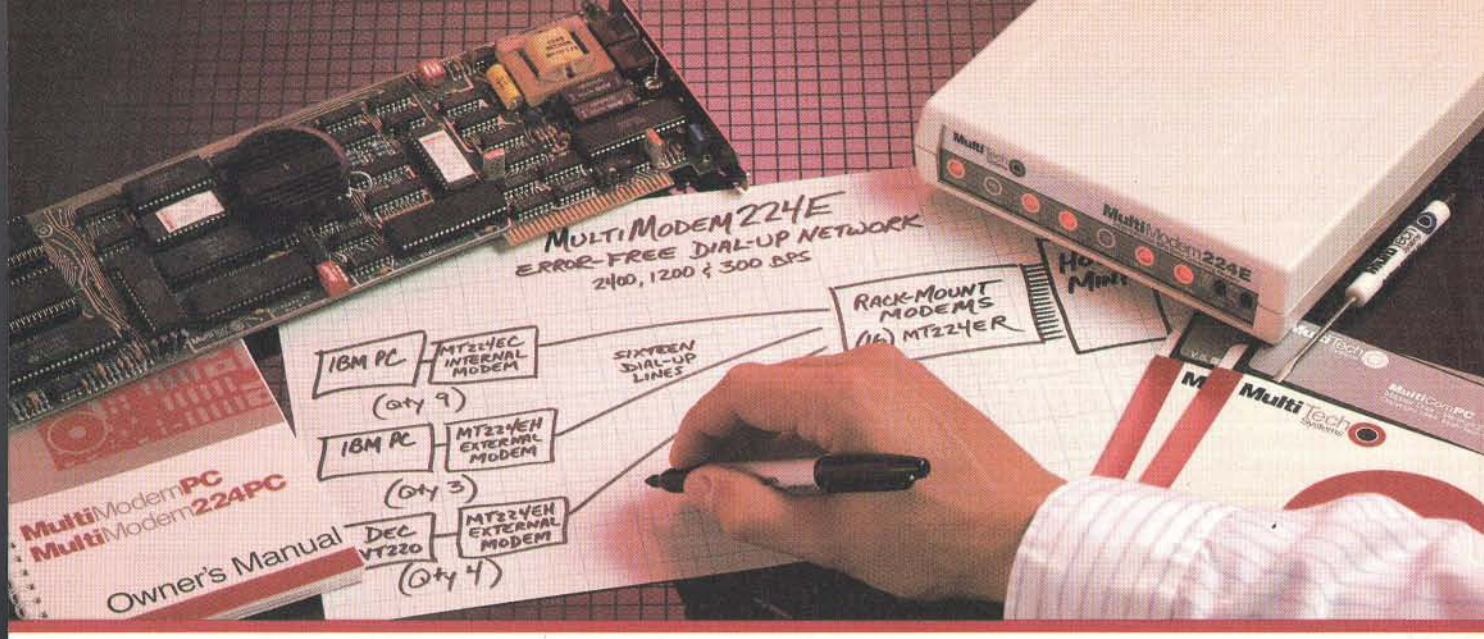
That is, the first argument is the drive identifier, and the second is the list of parameters to be used when formatting the disk.

If the drive identifier refers to a floppy drive, then it simply calls the standard format program (conveniently renamed FORMATX.COM). If a hard-disk identifier or an invalid identifier is given then it displays an error message.

```
echo off
if %1 == a: goto :a
if %1 == A: goto :a
if %1 == b: goto :b
if %1 == B: goto :b
echo  You may only format a disk in drive A or drive B!
echo  Please place a disk in drive A or B, then try
      again.
echo  Use the form:
echo        format a: /s/v
echo  where the first argument is the drive and the
      second is the list of parameters for the format
echo  command.
```

continued

Inquiry 39



Error-Correcting 2400 bps Modems from Multi-Tech Systems:

When it has to be as good as it is fast

- Dial-up 2400 bps modems have arrived. More datacomm users are upgrading from 1200 to 2400 than ever before. But there can be a flip side to increased speed: more transmission errors.
- That's why our MultiModem224E™ offers MNP™ error correction. Available in our 2400 bps desktop, internal and rack-mounted modems, MNP gives you 100% error-free transmissions, no matter how bad the phone line. MNP does it without the speed degradation of less efficient, software-based protocols.
- Another important point: MNP Class 3 has emerged as an industry standard. It's now in the public domain, and has been implemented in virtually all 2400 bps modems that offer error-correction.
- So, why buy error-correcting modems from Multi-Tech? There are many good reasons, including:

1. Multi-Tech modems are 100% Hayes-compatible (more so than Hayes' own 2400 bps modems*), and our MultiModem224E with error-correction costs less than a Hayes Smartmodem 2400™ without this feature.
2. Bonus features, like speed conversion, both synch and asynch operation, battery-backed option settings and phone number memory.
3. Versatility: the auto-dial/auto-answer MultiModem224E runs at 2400, 1200 or 300 bps, with or without error-correction, automatically!
4. Our two year warranty means something. Since Multi-Tech modems are designed and manufactured at our Minnesota headquarters (as they have been for the last sixteen years), you can be sure we'll be here when you need us.

- Please call us toll-free at **1-800-328-9717**, for additional information…get a modem that's as good as it is fast!

**InfoWorld–8/5/85–reprints available*

Trademarks: MultiModem and the Multi-Tech Systems logo: Multi-Tech Systems Inc. • MNP: Microcom Inc. Smartmodem: Hayes Microcomputer Products, Inc.

MultiTech Systems

Inquiry 352 for End-Users.
Inquiry 353 for DEALERS ONLY.

The right answer every time.

Multi-Tech Systems, Inc. • 82 Second Avenue S.E. • New Brighton, Minnesota 55112 U.S.A.
1-800-328-9717 • 1-612-631-3550 • TWX 910-563-3610 (Domestic) • Telex 4998372 MLTTC (International)



```
goto :bye
:a
:b formatx %1 %2
:bye
echo off
```

---

ibm.pc/software #1841, from skluger (Sigi Kluger, Definicon Systems), Tue Dec 2 16:35:03 1986. A comment to message 1839.

I am currently running 3.2 and I haven't gotten any error messages from your .BAT file, yet it doesn't work anyway. You cannot follow a label with a command, like

```
:ok format a:
```

because whatever follows the label on the same line is ignored. Also, you are not testing for lowercase "a:"...

Changing that line to two lines as in

```
:ok
format %1 %2 %3 %4 %5
```

worked for me. Also, this, of course, assumes you only want to format A:; how about B:? I even tried running it from a secondary COMMAND.COM, and it, too, worked!

---

ibm.pc/software #1842, from geary (Michael Geary), Tue Dec 2 20:48:48 1986. A comment to message 1839.

If you want to execute a secondary command processor and give it a command like DIR, do it like this:

```
command /c dir
```

You need the "/c". If you put anything before the /c, COMMAND thinks that is the directory you want to put into the COMSPEC setting. That's why it complained about the "COMMAND search directory."

As Sigi mentioned, you can't put a command on the same line as a label. Put it on the next line instead. Also, if you are writing a batch file to override a program like FORMAT, you should rename the .EXE or .COM file to a different name. If you're in the same directory as the program, it will go ahead and run the program, not the batch file. (The search order is .COM, .EXE, then .BAT.)

And, as you noted, DOS 3.2 has enough warnings in FORMAT.COM that batch files like this aren't really necessary any more. I just tried to format my hard disk:

```
C:\WINDOWS >
format c:
Enter current Volume Label for drive C: fixed disk

WARNING, ALL DATA ON NON-REMOVABLE DISK DRIVE C: WILL
BE LOST! Proceed with Format (Y/N)?n

C:\WINDOWS >
```

---

ibm.pc/software #1843, from skluger, Tue Dec 2 21:34:57 1986. A comment to message 1842.

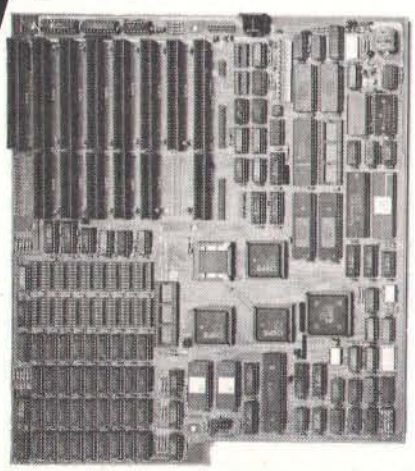
That is, if your hard disk has a volume label. If it doesn't, you will only get the WARNING message. I haven't formatted a hard disk in about 2 weeks so I don't quite remember, but I think it asks you AGAIN if you say yes the first time.

continued

AT MEMORY SOLUTION

3 MEGA BYTE AT-286 SYSTEM

AT MEMORY SOLUTION



⬅ TURBO AT-286 w/3MF Motherboard

- 80286 CPU
- 6/8, 6/10 or 6/12 Dual Speed (Keyboard Selectable)
- Phoenix BIOS
- On board Rechargeable Battery
- On Board Serial/Parallel/Game Port
- 3MB Memory Capacity On Board
- 80287 Socket Ready
- Chip Technology VLSI Chip Set

TURBO AT-286 System ➡

- 80286 CPU
- Phoenix BIOS
- 640K On Board Up To 3 MB
- Slide in Case w/220W Power Supply
- 6/8, 6/10 or 6/12 Dual Speed (Keyboard Selectable)
- 1.2 MB or 360K Floppy Drive
- Western Digital WA-2 Controller
- AT Type Keyboard
- Hardware Reset Ready
- Serial/Parallel/Game Port



WISETRON INT'L, INC.
(Manufactured for WiseTEK)
513 Valley Way
Milpitas, CA 95035
TEL: (408) 263-1237
FAX: (408) 263-1870

We also have **TURBO XT (4 LAYER)**, **MINI AT** (XT Size)

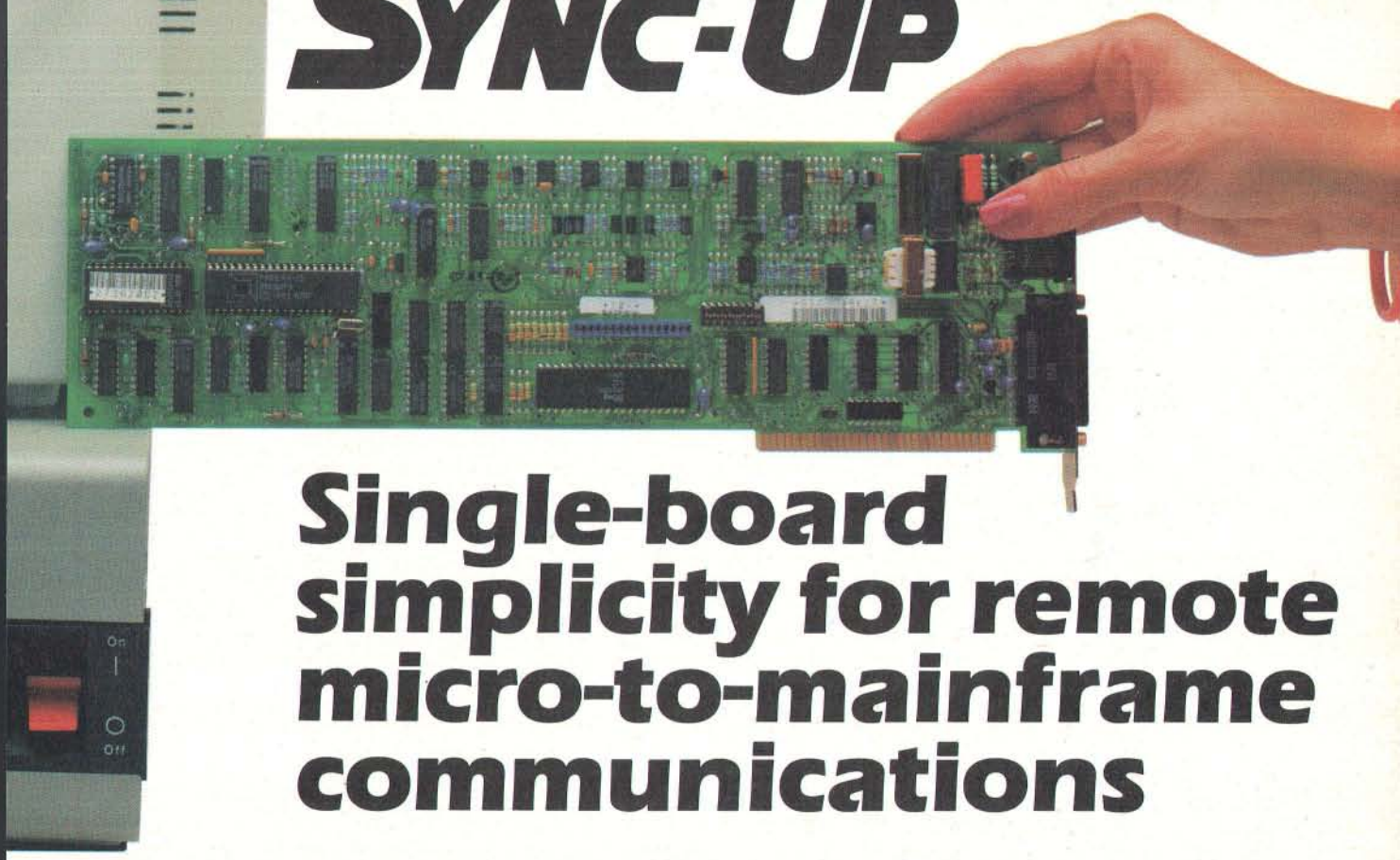
Distributors, Dealers, Education, Corporation, VAR, OEM Welcome

AT and XT are the registered trademark of International Business Machines.

MICRONIC INT'L CORP.
108 E. 16th Street
New York, NY 10003
TEL: (212) 529-4699
FAX: (212) 529-9926

Inquiry 334

SYNC-UP™



Single-board simplicity for remote micro-to-mainframe communications

A Sync-Up modem card — that's all you need to link your remote PC, XT, AT or compatible to your synchronous mainframe. And you can make the connection at 4800 bps, dial-up or dedicated line, or 2400 bps dial-up. Insert the modem into any expansion slot, plug in the Telco connector, install the communications software and your link is ready.

Sync-Up is simple. If your mainframe is supporting 201C or 208A/B modems, implementation is a matter of minutes, with no changes required at the mainframe end.

Sync-Up is versatile. It's available with the following UDS software options: DIAL for use with your existing emulator package; BSC for 2780/3780 or 3270 emulation; or SNA for 3270 or 3770 emulators. It supports most other synchronous communications packages.

Sync-Up is economical. Prices start at $625, quantity one, for a 201C without software.

Sync-Up is NOW. 201s and 208A/Bs are available for immediate shipment.

For technical details and complete pricing information, contact Universal Data Systems, 5000 Bradford Drive, Huntsville, AL 35805. Telephone 205/721-8000; Telex 752602 UDS HTV.

Universal Data Systems

MOTOROLA INC.
Information Systems Group

Inquiry 318

UDS modems are offered nationally by leading distributors. Call the nearest UDS office for distributor listings in your area.

DISTRICT OFFICES: **Apple Valley,** MN, 612/432-2344 • **Atlanta,** GA, 404/998-2715 • **Aurora,** CO, 303/368-9000 • **Blue Bell,** PA, 215/643-2336 • **Boston,** MA, 617/875-8868 • **Columbus,** OH, 614/895-3025 • **East Brunswick,** NJ, 201/238-1515 • **Glenview,** IL, 312/998-8180 • **Houston,** TX, 713/988-5506 • **Huntsville,** AL, 205/721-8000 • **Issaquah,** WA, 206/392-9600 • **Livonia,** MI, 313/522-4750 • **Mesa,** AZ, 602/820-6611 • **Milwaukee,** WI, 414/273-8743 • **Mission Viejo,** CA, 714/770-4555 • **Mountain View,** CA, 415/969-3323 • **Richardson,** TX, 214/680-0002 • **St. Louis,** MO, 314/434-4919 • **Silver Spring,** MD, 301/942-8558 • **Tampa,** FL, 813/684-0615 • **Uniondale,** NY, 516/222-0918 • **Van Nuys,** CA, 818/891-3282 • **Willowdale,** Ont, Can, 416/495-0008

Created by Dayner/Hall, Inc., Winter Park, Florida

OVERFLOWED ENVIRONMENT TABLE

ibm.pc/software #1846, from anon (John Masters), Thu Dec 4 13:36:31 1986.

I had an overflowed environment table and I added the line

```
SHELL=C:\bin\command.com /p/e:320
```

in my CONFIG.SYS. (By the way, I'm using DOS 3.2.) It's working fine in terms of the environment variable table size. However, one problem I am having is that COMMAND.COM doesn't execute AUTOEXEC.BAT automatically. I tried to add "/C autoexec" option to the line. Then it executes AUTOEXEC.BAT, but the control doesn't return to the terminal. It freezes the computer after it finishes executing AUTOEXEC.BAT. Anybody know how to expand the environment table size while having COMMAND.COM execute AUTOEXEC.BAT automatically?

---

ibm.pc/software #1847, from dondumitru (Donald Dumitru), Thu Dec 4 18:15:05 1986. A comment to message 1846.

I use

```
SHELL=C:\path\command.com c:\path /e:nn /p
```

where "path" is the path to the command processor, and "nn" is the environment size. This is under DOS 3.1, though I have the same thing on another system with DOS 3.2 - maybe there is a requirement on the order of the switches. (By the way - the c:\path thingy tells COMMAND.COM where to reload itself from.)

---

ibm.pc/software #1851, from geary, Fri Dec 5 01:03:33 1986. A comment to message 1846.

I have

```
SHELL=C:\bin\command.com /e:512 /p
```

and it works fine. AUTOEXEC.BAT is in the root directory; it's DOS 3.2. It also worked if I swapped the /p and /e:512.

---

ibm.pc/software #1858, from gstrahl (George Strahl), Sun Dec 7 20:32:37 1986. A comment to message 1851.

I thought the /p option indicated that the AUTOEXEC.BAT should be executed next. My XT clone works nicely with

```
SHELL=C:\command.com c:\ /p,
```

although I have not used the /e:xxx option. Am I wrong about the /p usage?

---

ibm.pc/software #1859, from dmick (Dan Mick), Sun Dec 7 20:37:58 1986. A comment to message 1858.

/p means that a copy of COMMAND is permanent and should not be removed upon receipt of an EXIT command. I don't know whether it affects AUTOEXEC execution or not.

---

ibm.pc/software #1861, from geary, Mon Dec 8 04:03:36 1986. A comment to message 1859.

Yes, /p means both those things: Make COMMAND.COM permanent, and execute AUTOEXEC.BAT.

COM PORTS

ibm.pc/hardware #1655, from dmick, Wed Nov 19 13:25:14 1986.

All this talk about COMn has me confused. On the PC XT-class machines, COM1 is the 3xx addresses, COM2 is the 2xx addresses, and each have their own IRQ (3 and 4, I think, but whatever). What are COM3-whatever? Qmodem lets me do alla way up to COM16, but what good does that do unless there's a reasonably standard port/IRQ mapping for them?

---

ibm.pc/hardware #1656, from skluger, Wed Nov 19 13:52:14 1986. A comment to message 1655.

According to my ProYAM manual, here are COMn ports/IRQs:

COM3	3E8	IRQ4
COM4	2E8	IRQ3
COM5	2B8	IRQ3
COM6	2B8	IRQ2
COM7	2F8	IRQ2
OM8	278	IRQ2

(The last three are marked "alternate for IBM" and COM5 is marked "Columbia".)

---

ibm.pc/hardware #1658, from geary, Wed Nov 19 19:03:43 1986. A comment to message 1655.

COM1 and COM2 are the only "standard" ports, and they're as you describe. Serial card vendors can, of course, build nonstandard cards using whatever port addresses and interrupt vectors they choose. Or even different serial chips. How they're addressed (COM3, FOOBAR4, etc.) is entirely up to the software used with them.

---

ibm.pc/hardware #1682, from rlatham (Richard Latham), Thu Nov 20 22:12:27 1986. A comment to message 1656.

The guys who originally wrote the BIOS obviously expected to run up to four serial ports. They left room in the equipment list area for four UART addresses.

---

ibm.pc/hardware #1692, from geary, Fri Nov 21 02:28:56 1986. A comment to message 1682.

That's right, and there is also room for four parallel printer port addresses in that same area. It's interesting to look over the BIOS and hardware design - the PC architecture was obviously thrown together in a big hurry. (I get a kick out of seeing the light pen connector on the monochrome display adapter, which is not usable because of the long-persistence phosphor on the monochrome display.)

---

ibm.pc/hardware #1708, from dmick, Sat Nov 22 00:44:08 1986. A comment to message 1692.

Depends on the monitor. We can use the pen with a Paradise board, anyway. But you've gotta really crank the contrast, and the FTG does a worse job than the Micrografx. But it works...sorta....

---

ibm.pc/hardware #1827, from jmonti (Joe Miramonti), Sun Dec 7 02:35:40 1986. A comment to message 1656.

Based on my use of an Everex half-card modem, and the ProComm software, and some playing around with Debug, here is my understanding of the interactions between COM1, COM2, and additional ports. Here are the apparent addresses and hardware. Interrupt assignments for the four "supported" COMn: ports, as recognized for my system:

BASE	ADDR	IRQx	INTx
COM1:	3F8	4	0C
COM2:	2F8	3	0B
COM3:	6F8	4	0C
COM4:	7F8	3	0B

When DOS first loads, vectors 06, 07, 0B, and 0C all point to a dummy routine, since DOS supports only noninterrupt-driven serial I/O through the BIOS. The BIOS has support for 4 serial ports and maintains a four-entry table (called RS232_BASE in the BIOS listings) to store the I/O port addresses. BIOS I/O is performed through software INT 14h with a code of 0-3 in DX, which acts as an index into the port addresses in RS232_BASE. The BIOS then performs wait-mode I/O, without benefit of interrupts.

ProComm gets around this restriction by taking over the hardware interrupt vector 0B if COM2: or COM4: has

continued

TEST EQUIPMENT THAT MEASURES UP TO YOUR SPECIFICATIONS



DMM-300 $79.95

3.5 DIGIT DMM / MULTITESTER

Our best model. A highly accurate, full function DMM loaded with many extra features. Audible continuity, capacitance, transistor, temperature and conductance all in one hand-held meter. Temperature probe, test leads and battery included.

- Basic DC accuracy: plus or minus 0.25%
- DC voltage: 200mv — 1000v, 5 ranges
- AC voltage: 200mv — 750v, 5 ranges
- Resistance: 200 ohms — 20M ohms, 6 ranges
- AC/DC current: 200uA — 10A, 6 ranges
- Capacitance: 2000pf — 20uf, 3 ranges
- Transistor tester: hFE test, NPN, PNP
- Temperature tester: 0° — 2000° F
- Conductance: 200ns
- Fully over-load protected
- Input impedance: 10M ohm



DMM-200 $49.95

3.5 DIGIT FULL FUNCTION DMM

High accuracy, 20 amp current capability and many range settings make this model ideal for serious bench or field work. Tilt stand for hands-free operation. 2000 hour battery life with standard 9v cell. Probes and battery included.

- Basic DC accuracy: plus or minus 0.25%
- DC voltage: 200mv — 1000v, 5 ranges
- AC voltage: 200mv — 750v, 5 ranges
- Resistance: 200 ohms — 20M ohms, 6 ranges
- AC/DC current: 200uA — 20A, 6 ranges
- Fully over-load protected
- Input impedance: 10M ohm
- 180 x 86 x 37mm, weighs 320 grams



DMM-700 $49.95

3.5 DIGIT AUTORANGING DMM

Autorange convenience or fully manual operation. Selectable LO OHM mode permits accurate in-circuit resistance measurements involving semi-conductor junctions. MEM mode for measurements relative to a specific reading. Probes and battery included.

- Basic DC accuracy: plus or minus 0.5%
- DC voltage: 200mv — 1000v, autoranging or 5 manual ranges
- AC voltage: 2v — 750v, autoranging or 4 manual ranges
- Resistance: 200 ohms — 20M ohms, autoranging
- AC/DC current: 20mA — 10A, 2 ranges
- Fully over-load protected
- Audible continuity tester
- Input impedance: 10M ohm
- 150 x 75 x 34mm, weighs 230 grams

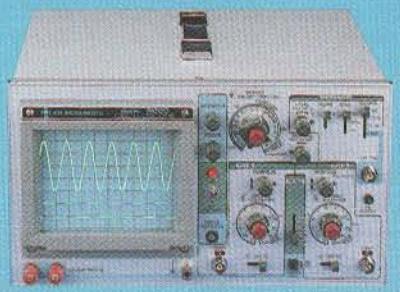


DMM-100 $29.95

3.5 DIGIT POCKET SIZE DMM

Shirt-pocket portability with no compromise in features or accuracy. Large, easy to read .5" LCD display. 2000 hour battery life with standard 9v cell provides over two years of average use. Probes and battery included.

- Basic DC accuracy: plus or minus 0.5%
- DC voltage: 2v — 1000v, 4 ranges
- AC voltage: 200v — 750v, 2 ranges
- Resistance: 2k ohms — 2M ohms, 4 ranges
- DC current: 2mA — 2A, 4 ranges
- Fully over-load protected
- Input impedance: 10M ohm
- 130 x 75 x 28mm, weighs 195 grams

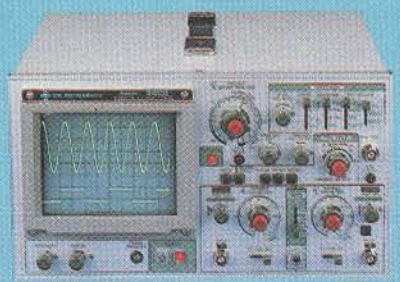


MODEL 2000 $349.95

20 MHz DUAL TRACE OSCILLOSCOPE

Model 2000 combines useful features and exacting quality. Frequency calculation and phase measurement are quick and easy in the X-Y Mode. Service technicians will appreciate the TV Sync circuitry for viewing TV-V and TV-H as well as accurate synchronization of the Video Signal, Blanking Pedestals, VITS and Verticle/Horizontal sync pulses.

- Lab quality compensated 10X probes included
- Built-in component tester
- 110/220 Volt operation
- X-Y operation
- Bright 5" CRT
- TV Sync filter



MODEL 3500 $499.95

35 MHz DUAL TRACE OSCILLOSCOPE

Wide bandwidth and exceptional 1mV/DIV sensitivity make the Model 3500 a powerful diagnostic tool for engineers or technicians. Delayed triggering allows any portion of a waveform to be isolated and expanded for closer inspection. Variable Holdoff makes possible the stable viewing of complex waveforms.

- Lab quality compensated 10X probes included
- Delayed and single sweep modes
- Z Axis intensity modulation
- X-Y operation
- Bright 5" CRT
- TV Sync filter



DPM-1000 $54.95

3.5 DIGIT PROBE TYPE DMM

Autoranging, pen style design for the ultimate in portability and ease of use. Custom 80 pin LSI chip increases reliability. Audible continuity tester and data hold feature for added convenience. Case, test leads and batteries included.

- Basic DC accuracy: plus or minus 1%
- DC voltage: 2v — 500v, autoranging
- AC voltage: 2v — 500v, autoranging
- Resistance: 2k ohms — 2M ohms, autoranging
- Fully over-load protected
- Input impedance: 11M ohm
- 162 x 28 x 17mm, weighs 75 grams

2 YEAR WARRANTY ON ALL MODELS

MasterCard VISA

JDR INSTRUMENTS

110 Knowles Drive, Los Gatos, CA 95030

(408) 866-6200 • FAX (408) 378-8927 • Telex 171-110

ORDER TOLL FREE 800-538-5000

OR VISIT OUR RETAIL STORE
1256 SOUTH BASCOM AVE.
SAN JOSE, CA. (408) 947-8881

Inquiry 151

COPYRIGHT 1986 JDR MICRODEVICES
THE JDR INSTRUMENTS LOGO IS A REGISTERED TRADEMARK OF JDR MICRODEVICES.
JDR INSTRUMENTS IS A TRADEMARK OF JDR MICRODEVICES.

been selected, or hardware vector 0C if COM1: or COM3: was selected. It does this on the fly as you change the "parameter" settings (Alt-p). This can be seen easily by changing the COMn: settings, opening a "DOS-Gateway" (alt-F4), and running either of the excellent memory-mapping utilities (PMAP or MAPMEM), which, among other things, will show which resident programs stole which vectors.

The problem with all this is that even and odd ports share the same hardware interrupt vectors. On a machine with a well-designed I/O channel (BUS), like the DEC 11/XX series computers, this would be no problem, since the multiple interrupts would be "either'ed" or "or'ed" electrically or "chained" and the processor could then go out and read status ports to find out which COMn: interrupted (POLLING). IBM, however, curiously put tri-state drivers on the IRQx (interrupt request) lines. (Tri-state means positive, negative, or open circuit). These types of drivers short out if more than one is enabled for a given interrupt line. These drivers are enabled whenever hardware ints are enabled (bit 3 in port ?FCh - modem line control - is set).

The point of all this is that you can have beaucoup ports connected to IRQ3 (or IRQ4), but only one can have interrupts enabled. You can't, for example, have your mouse hooked up to COM1:/COM2: and expect to use COM3:/COM4: for ProComm. Both ports get ints enabled and you end up with tri-state drivers shorting each other out (almost as bad as it sounds, but the boards won't be harmed). This causes you to lock up your mouse, and while ProComm will dial any number you like, you won't see anything on the screen. You CAN, however, put a noninterrupt-driven device like a serial plotter on COM1: and your interrupt-driven mouse on COM2: and use COM3: for mostly-interrupt-driven ProComm.

The upshot of all this for software writers is that if you're going to use COM3:/COM4: with interrupts, then you must first check for interrupts enabled on COM1:/COM2:, and vice versa. (And, if so, remedy the situation.) ProComm does not do this; an easy oversight to make.

If any of this is incorrect, please let me know.
Skip the next message if you've already read more than you wanted to.

Ibm.pc/hardware #1828, from jmonti, Sun Dec 7 02:38:29 1986. A comment to message 1827.

As a diversion, I was curious what would happen if I were to modify the bus drivers on my serial card and my modem card, making them open-emitter drivers, so that the bus or'ed the multiple interrupt requests. (The actual implementation was 1N914 diodes terminating into about a 1K resister to ground. This gave about 0.0/2.5 volt levels. Pretty bad, but better than the 0.5 volt I was seeing with the drivers battling each other.

Sadly, while the hardware could now support multiple interrupts with polling, the software was not up to the mark. I mention it, however, as a viable solution if anyone needed to design a custom system with more than two interrupt-driven serial ports. And for those who are curious about such things, as I am, the interrupt latency on an 8088, at 4.77 MHz, is 60 microseconds (worst case 200), and on an 8086 at 9.54 MHz is 20 microseconds (worst case 50). If anyone knows the figures for an AT, please let me know. (Times were from the rise of IRQ3 till it fell back -- time till serial port read.)

Ibm.pc/hardware #1829, from barryn (Barry Nance), Sun Dec 7 10:44:38 1986. A comment to message 1828.

Interesting, Joe. Do you want some configurable/modifiable communications software to try out with the "new" hardware? Take a look at "telecomm.tech/example.code," and watch (shortly) for a buffered, interrupt-driven int 14 replacement that I'll be posting.

Ibm.pc/hardware #1832, from geary, Mon Dec 8 04:06:18 1986. A comment to message 1827.

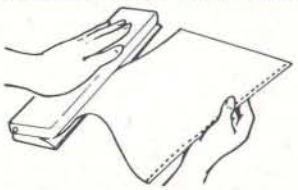
Keep in mind that these port assignments apply only to the Everex modem. If another manufacturer's modem or serial card allows selection of COM3 or COM4, they may or may not follow the same port and interrupt assignments.

APPLE II/MACINTOSH

The Macintosh thread is based on a long message on truncating Macintosh interface files for faster program compilation times. The first Apple II thread deals with whether it is possible to BLOAD a text file in DOS 3.3. The next thread looks at accessing a clock through ProDOS on the IIGS, and leads to a general discussion on slots and devices. The final thread looks at what is required to boot from the RAM disk on the IIGS.

NEW PRODUCTS
Mountain COMPUTER PRODUCTS
20 meg drive card for XT or AT
No. 99620 ..... **$529**
30 meg drive card for XT or AT
No. 99600 ..... **$619**
20 meg hard drive w/controller hardware and software 65MS
No. 96835 ..... **$439**
30 meg hard drive w/controller hardware and software 65MS
No. 96836 ..... **$509**
1 YEAR WARRANTY ON ALL MOUNTAIN PRODUCTS
The Wholesale Outlet • To Order Call
1 Interstate Avenue
Albany, N.Y. 12205
Dept. BYM
518-459-7883
Catalog also available
MC/VISA OR COD CASH
All orders shipped FOB Albany • Prices subject to change

Inquiry 329

"THE STRIPPER"

SAVES TIME . . .
SAVES MONEY
REMOVES PERFORATED EDGES FROM:
• PRINTER PAPER
• MULTIPLE PART CHECKS
• INVOICES/STATEMENTS
AVAILABLE AT LEADING OFFICE/COMPUTER SUPPLY STORES OR CALL **TOLL FREE**
Ra-Lo INC.,
1-800-334-5447 OR 1-800-637-3524 (WA)
(509) 928-4139
VISA/MASTERCARD
$14.95 plus $2.00 Postage and Handling
DEALER INQUIRIES INVITED

Inquiry 253

MULTIPLY THE VALUE OF TURBO PASCAL*
SUPPORTS NETWORKING
Supercharge your TURBO Pascal with **TURBOLINK +** and add the capabilities that transform TURBO Pascal into the most powerful software development tool available today:
- Create 576 K TURBO Pascal Programs
- Call Pascal Modules from:
  — BASIC, BASICA, Compiled BASIC
  — MS Pascal and FORTRAN
  — Lattice C, Assembly Language
  — Standard, 8087, BCD TURBO Pascal
  — **TURBO Pascal version 3.02A (Supports networking)**
  — TURBO Prolog
- Automatically Generate Turbo Pascal Compatible Inline Machine Code
- Use all TURBO Pascal variants together in a single program
- **Includes complete matrix operations library**

Order TURBOLINK + today for only:
$149.95 (S&H Included) (foreign orders add $10.00)
CALL (303) 971-0729
Inquiries, Orders (VISA, MC): 9:00am-1:00pm, MT, Mon.-Fri.
Technical Information: 5:00pm-7:00pm, MT, Mon., Thurs.
PATHFINDER SOFTWARE, INC.
P.O. BOX 43
LITTLETON, COLORADO 80160
*TURBO Pascal is a registered trademark of Borland International

Inquiry 218

TRUNCATING INTERFACE FILES

macintosh/softw.devlpmt #685, from ccrawfor (Chris Crawford), Mon Dec 1 21:43:13 1986.

Some of you may recall that awhile back I posted results of a direct comparison of compilation times for the same program in Lisa Pascal and MPW Pascal. You will recall that the timings were 7 minutes for Lisa Pascal, 8 minutes for MPW Pascal on a 512K Mac, and 6 minutes on a Mac Plus. I made an experiment today that has striking implications. What I did was to carry over my truncated OSIntf, ToolIntf, and PackIntf files from Lisa Pascal to MPW.

An explanation is in order at this point.

Every Mac Pascal program that makes use of the Toolbox and OS must use these interface files to tell the Pascal compiler where all the Toolbox and OS routines are. Of course, with a Toolbox as big as the Mac's, that adds up to a bunch of interface stuff. As it happens, any given program will likely use only a fraction of the stuff in the interface files. What I did was to go through the interface files, ripping out all references to stuff I knew I wouldn't use. This created my truncated OSIntf, ToolIntf, and PackIntf files.

Now, my earlier comparison was unfair to MPW, because I used the truncated files for Lisa Pascal but not for MPW. I didn't think there'd be much difference. Boy, was I wrong! When I ported over the truncated files and ran the test, I got a time of 5 minutes, 15 seconds on a 512K Mac. That's only about 65% of the time that the compilation with regular files takes!

The conclusion I draw from this is that those interface files really cost lots of compilation time. My truncation was not heavy-handed; I could probably go through my truncated files and remove as much material from them as I have already removed.

And it is here that I finally come to the debatable point I would like to present. How far should I go in this effort? The temptation is to rip and slash out anything that I do recognize. My fear, though, is three-fold: 1) How do I know that minor routines that I don't recognize aren't called by higher-level routines that I *do* use? Might this somehow confuse the compiler? 2) How do I know that the routine I am NOT using today may become necessary tomorrow? 3) Is there some chance that such radical surgery might not cause weird bugs further down the road? Or that the truncated material might contain information necessary for my program to run on machines with other configurations than mine?

Some of these concerns may seem paranoid to you, but my first line of defense against bugs has always been hysterical paranoia.

macintosh/softw.devlpmt #693, from scotty (Barry Wilson), Wed Dec 3 20:21:25 1986. A comment to message 685.

I've been using a {$LOAD} compiler directive in my uses statements. The syntax is {$LOAD filename}. This dumps the symbol table the first time it is encountered and then loads it on consecutive compiles. Only problem is that if the heap is fragmented enough, you end up with some weird errors. This is apparently because the {$LOAD} expects the symbol tables to get loaded into the heap contiguously. Other than that, it speeds compiles up tremendously. Now, if only something could be done about Links...

DOS 3.3 POKE FOR BLOAD

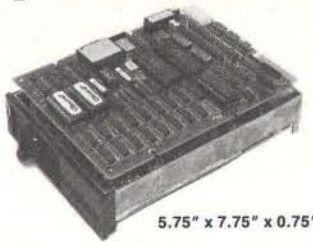
apple/software #444, from bill.p (Bill A. Pugh), Thu Dec 18 19:04:23 1986.

Any DOS 3.3 experts out there? If so, I need help from

continued

Inquiry 92

IBM PC AT performance! PCjr price!



5.75" x 7.75" x 0.75"

★ **AMPRO** LITTLE BOARD/186
- 8Mhz 16 Bit 80186 CPU
- 512K RAM—No Wait-States
- 2 Serial Ports 50-38.4K Baud
- Parallel Printer Port
- 4 Drive Mini/Micro Floppy Controller
- SCSI Bus Hard Disk Interface
- DOS Compatible ROM-BIOS
- Boots PC DOS 2.x, 3.x

Computer Board Assembled & Tested w/Tech Manual & DOS Utilities ..... **$489.**

★ MS DOS 3.2 & GW BASIC ..... **$89.**

★ 512K EXPANSION BOARD (1Mb Total) 8087 Socket, Clock, 2 Channel RS232/422, Buffered Expansion Bus & More ..... from **$149.**

★ **AMPRO** LITTLE BOARD (Z80) same as 80186 Board but Z80A CPU, 64K RAM, 16K EPROM, CPM 2.2, ZCPR3 & Manuals **$239.** With SCSI Hard Disk Interface **$279.**

☆ ENCLOSURES w/POWER SUPPLY ..... from **$99.**

☆ 5.25" DS 360K FLOPPY DRIVE ..... **$99.**

☆ 3.5" DS 720K MICRO FLOPPY DRIVE ..... **$139.**

☆ **XEBEC** OWL 10Mb SASI DRIVE w/Built-In Controller ..... **$449.**

☆ **SEAGATE** ST225N 20Mb SCSI Low Power ½ Ht Drive ..... **$549.**

☆ **WYSE & KIMTRON** TERMINALS ..... from **$395.**

Complete technical support. Complete systems available. Write or call for more information. Most orders shipped same day. Prices and availability subject to change.

VISA, Mastercard, Money Order, COD. Checks allow two weeks. Purchase Orders welcome. Prices FOB Buffalo Grove, IL.

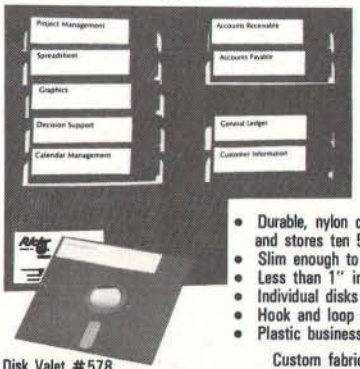
IBM PC AT, PCjr, PC DOS are trademarks of International Business Machines Corporation. Little Board is a trademark of Ampro Computers, Inc. Concurrent DOS is a trademark of Digital Research, Inc.

DISKS PLUS, INC.
356 Lexington Drive
Buffalo Grove, IL 60089-2312
TLX: 650 249 2139 MCI UW
(312) 537-7888

DISKS PLUS
Microcomputers and Accessories

disk valet™

Unconditional money back guarantee.



Each black valet is **$9.95**

Shipping & Handling is $3.00 for the first valet, $.50 more for each additional valet. FL residents add 5% sales tax

- Durable, nylon construction conveniently transports and stores ten 5¼" disks in individual pockets.
- Slim enough to carry in a briefcase or purse.
- Less than 1" in thickness fully loaded.
- Individual disks quickly and easily identified.
- Hook and loop closure.
- Plastic business or ID card window.

Custom fabric color & Imprinting available for Corporate or oganization identification!

Disk Valet #578 (11¼" x 7")

Ricks® Industries, Inc. 7800 N.W. 32nd Street
P.O. Box 520646 • Miami, Florida 33152-0646

Order Placement numbers - (800) 327-2303 or in Florida (305) 592-8767

☐ Please send me _____ disk valet(s).
☐ Check enclosed (Payable to Ricks Industries, Inc.)
☐ Please charge my: ☐ Visa ☐ MC

Acct. # _____ Expiration Date _____

Company _____ Title _____

Signature _____

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

Dealer, Distributor and Volume Inquiries invited.

Inquiry 260

Lotus HAL Lets You Do More With (And Get More From) 1-2-3 Than Ever Before.

Lotus HAL™ is a memory resident companion product for Lotus 1-2-3® that enhances the full range of 1-2-3's capabilities—and adds new ones.

It increases 1-2-3's power and flexibility, so you can work more efficiently and become more productive than ever before.

Benefits For All 1-2-3 Users

Lotus HAL works by giving you easier access to all of 1-2-3's numerous capabilities. And it's extremely useful for 1-2-3 users of all levels.

If you're new to 1-2-3, Lotus HAL will let you use it with greater confidence and speed.

If you're familiar with 1-2-3, Lotus HAL will make it easier for you to access additional power and capabilities.

And if you're an advanced 1-2-3 user, Lotus HAL will show you new features and functions that will add extra flexibility to the power of 1-2-3 you've already tapped.

How does Lotus HAL do all this—for all users?

Easier Commands

Lotus HAL makes executing 1-2-3 procedures even easier than before. Because it accepts phrases like "total sales," "graph Jan to Mar," or "copy this to A10," etc. In fact, Lotus HAL's vocabulary includes English words and phrases. So you can customize a command dictionary of your own—with the words and operations you're most used to and most comfortable using.

Since Lotus HAL makes 1-2-3 more accessible for all users, you'll learn more—in less time—about all the capabilities of 1-2-3.

For instance, if you're presently using only the spreadsheet, Lotus HAL will show you how to create graphs and do database functions—far more simply than ever before.

Time-Saving Shortcuts, Easy-To-Create Macros

With Lotus HAL, you'll take shortcuts and accomplish multi-step tasks quickly and easily. So you'll greatly reduce errors—and save time.

And, with a simple "undo" command, Lotus HAL even lets you recover from errors you've already made. So if you're a novice user, you'll learn faster and with greater confidence. And if you're an experienced user, you can experiment more freely and do "what ifs"—without fear of having a mistake destroy hours of work.

Lotus HAL also makes developing macros simpler than ever—so simple, in fact, that even novice users can create 1-2-3 macros with Lotus HAL. And no matter how familiar with 1-2-3 you are, you'll benefit from being able to write and test macros to make sure they do what you had in mind.

New Power

Lotus HAL will let you take 1-2-3 as far as you need. And if you've been taking it far already, Lotus HAL offers you new commands that will further enhance your productivity.

For example, Lotus HAL lets you replace items anywhere in the worksheet (even within formulas), and create a dynamic link between cells in multiple worksheets. It also lets you audit your worksheet—so you can find mistakes without having to review the entire sheet "manually."

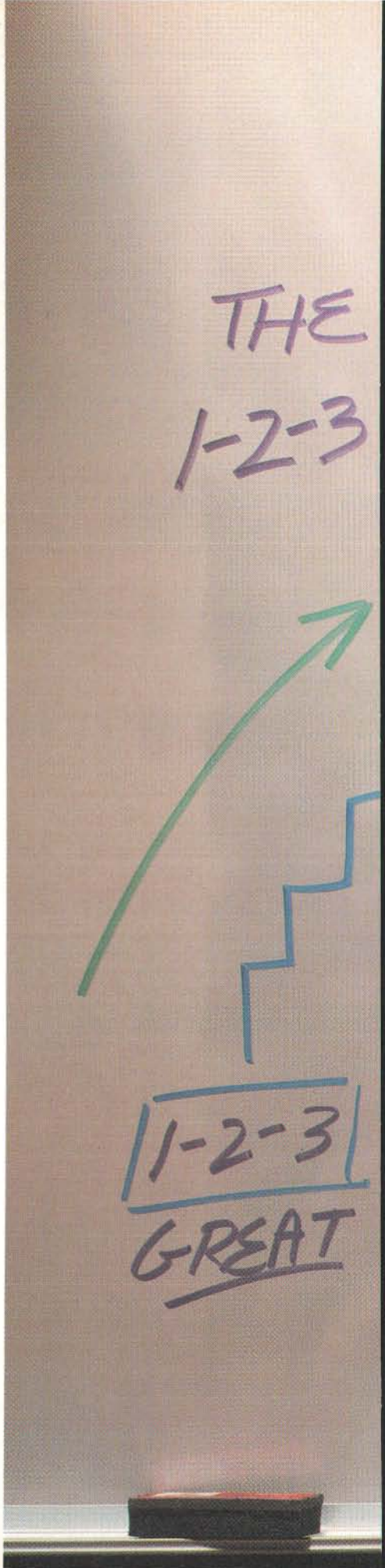
Best of all, while Lotus HAL greatly enhances 1-2-3's commands, it doesn't change either 1-2-3 or the worksheet. It's always available, but it never gets in your way. And you can share data as freely when you're using Lotus HAL as you did when you were using 1-2-3 alone.

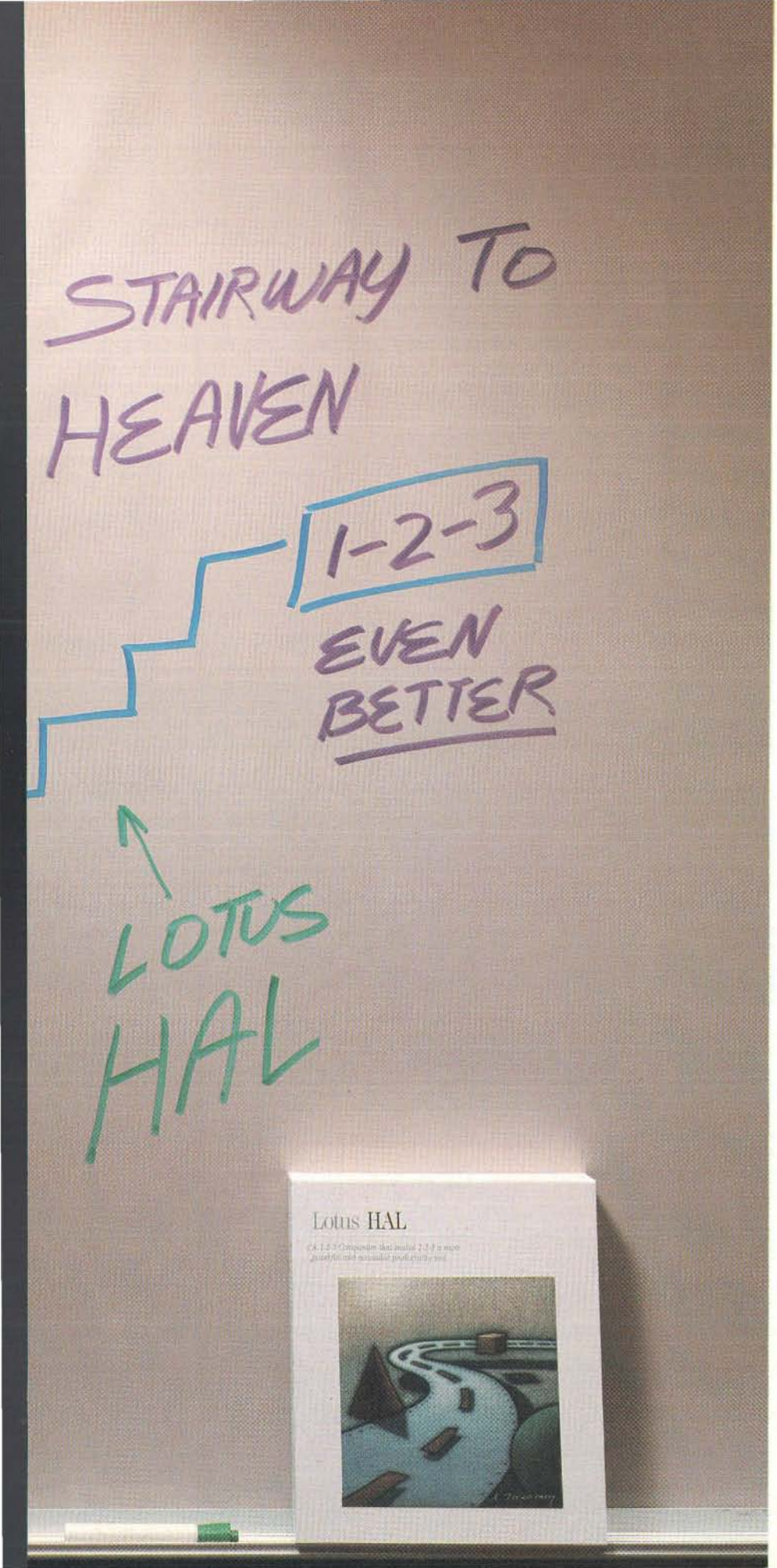
In fact, you can do everything you've ever done with 1-2-3 even better...plus a great deal more.

And since Lotus HAL is part of the 1-2-3 system—and the Lotus family—you get an unparalleled commitment to customer service and support that will keep you up and running.

© 1987 Lotus Development Corporation.
Lotus and 1-2-3 are registered trademarks of Lotus Development Corporation. Lotus HAL and 1-2-3 Companion are trademarks of Lotus Development Corporation.
Lotus HAL is distinguished from HAL which is a trademark of Qantel for its Hotel and Leisure Software.

System Requirements.
Lotus HAL requires 1-2-3 Release 1A, Release 2 or Release 2.01 for personal computers from IBM,* COMPAQ, and AT&T, plus 1-2-3 Certified Compatibles; DOS 2.0 or higher. Please refer to your 1-2-3 package or 1-2-3 documentation for appropriate hardware configurations and DOS requirements or consult your dealer.
Lotus HAL resides in memory with 1-2-3 and operates with it; a minimum system configuration of 512K is required.
*Lotus HAL does not operate with 1-2-3 for the IBM PCjr (ROM version), IBM PC Convertible or Release 1A for the IBM 3270 PC.





Make 1-2-3 even better... with Lotus HAL.

If you are among the two million people working with Lotus 1-2-3, you owe it to yourself to try Lotus HAL.

You'll save time...increase your productivity on 1-2-3...enjoy new functionality... unleash new power.

You'll see how easily you can execute 1-2-3 commands. And how the "undo command" can rescue you from serious errors you've already made.

And, you'll do so at a remarkably low price. Because Lotus HAL costs only $150.

Visit your local authorized Lotus dealer or if you're already convinced, simply use the coupon below to order Lotus HAL directly from Lotus.

Or order Lotus HAL (**Product No. YM-1377**), by calling Lotus, toll free, at

1-800-345-1043.

Lotus HAL

A 1-2-3 Companion™ that makes 1-2-3 a more powerful and accessible productivity tool.

Complete and return to: Lotus Development Corporation, 90 Annex, Atlanta, Georgia, 30390-0370 or call 1-800-345-1043.

☐ Yes. I'd like to try Lotus HAL for 30 days without obligation. **(YM-1377)**

☐ Please send more information about Lotus HAL. **(YM-1385)**

Send me___ unit(s) of HAL @ $150 each _____

Sales Tax** . . . . . _____

Total . . . . . _____

☐ I've enclosed my check or money order made payable to: Lotus Development Corporation.

Please charge my: ☐ VISA ☐ MasterCard

Card No. | | | | | | | | | | | | | | | | |

Expiration Date _____ / _____

Signature _____

Name _____

Company _____

Address _____

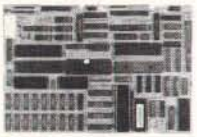
City _____ State _____ Zip _____

Phone (_____) _____

**Residents of the following states apply applicable sales tax: CA, DE, FL, GA, MA, MD, MI, MN, MO, NJ, NY, OH, TX, VA, WA. Offer good in U.S.A. and Canada only. In Canada make payment by credit card or International Postal Money Order. CODs and purchase orders will not be accepted.

When you purchase Lotus HAL directly from Lotus, take your first 30 days to try it out. If after 30 days Lotus HAL does not perform as described and you've purchased it directly from Lotus, we'll gladly give you a full refund.

New Quark®/PC Single Board Computer



Base model 5.75" x 8"

Only $395.

Reg. Price ~~$495~~

Quantity discounts available

- IBM PC® compatible single board computer mounts to 5¼" drive
- Includes Floppy Disk & Color Graphics CRT Controllers plus more

Also includes: Legal BIOS • Boots MSDOS® • Printer Port • 2 Serial Ports • 256K RAM • Clock Speed at 4.77 MHz • Alphanumerics and Graphics Modes for Color Video Controller • Standard IBM® Keyboard Port.

Options include: 512K RAM • Piggyback I/O channel OEM Expansion Board • XT-Compatible Hard Disk SCSI Interface • Real Time Clock with battery-back-up • Clock speed of 9.5 MHz (Twice as fast as a PC)

The Megatel Quark/PC is for OEM and end user applications that require PC compatibility in a compact single board computer. The Quark/PC BIOS will run most IBM PC® software including Flight Simulator and Lotus®. To meet your specifications a set of options let you add memory, speed and XT-compatible hard disk interface. Not only does it quickly mount to a 5¼" drive, it also comes with floppy disk and CRT color graphics controllers — all for just $395.

To order or enquire call us today. Dealer enquiries welcome. Megatel Computer Technologies (416) 745-7214 150 Turbine Drive, Weston, Ontario M9L 2S2 Telex: 065-27453 U.S. Address: 1051 Clinton St., Buffalo, N.Y. 14206 Distributors: NCS Electronics Varese, Italy • SES Electronics Nordlingen, Germany • Perdix Microtronics Biggin Hill, U.K. • Microcomputing Ghent, Belgium • Asp Microcomputers Melborne, Australia

Quark is a registered trademark of F. and K. MFG. CO. LTD.. IBM, IBM PC and PCDOS are registered trademarks of International Business Machines Corp. Lotus is a registered trademark of Lotus Development Corp. MSDOS is a registered trademark of Microsoft Corp.

See us at Cebit Stand #EO 6

megatel

UX-BASIC+™

The profitable way to program on XENIX.™

PC/AT DEVELOPMENT SYSTEM $595

UX-Basic+ is the choice of leading UNIX™ corporations like IBM, AT&T, NCR and Siemens as well as thousands of professional programmers.

UX-Basic+ provides

- powerful structured business Basic
- C-ISAM™ routines for Informix™ compatibility
- direct access to XENIX system calls
- Native Code Compiler for highest performance (available as part of the Performance System, $795)

UX-Basic+ is available under XENIX on the IBM, Compaq, and other PC/AT compatibles as well as on a wide range of UNIX systems.

HCR

HCR Corporation

130 Bloor Street West
10th Floor
Toronto, Ontario
Canada M5S 1N5

Telephone (416) 922-1937
Telex 06-218072 HCR TOR
Fax (416) 922-8397

UX-Basic+ is a trademark of UX Software Inc. *XENIX* is a trademark of MicroSoft Corp. *UNIX* is a registered trademark of AT&T in the USA and other countires. *C-ISAM* and *Informix* are trademarks of Informix Software Inc.

you. Is it possible to directly BLOAD a text file into memory? I'm thinking of making a very small patch or poke(s) to DOS 3.3 in memory to get it to ignore the type of file that is specified so that it will load the data in the text file straight into memory as if it were a binary file. Anyone know how?
bill.p

---

apple/software #445, from jerryh (Jerry Hewett), Fri Dec 19 12:36:58 1986. A comment to message 444.

Yes, it is possible to BLOAD text files from Sloth 3.3 -- I just wish I could remember what I changed and where to make it possible (we're talking a *long* time ago...). Why would you want to modify Sloth 3.3 when ProDOS does that (and a whole lot more!) already? You can load *anything* into memory -- even a directory or subdirectory! The feature is built into ProDOS. In your case, the command would be:

```
BLOAD <filename>,TTXT,A$<address>
```

Is there a really good reason why you haven't dropped Sloth 3.3 like a hot rock and moved over to ProDOS?

---

apple/software #446, from mdavis (Morgan Davis), Fri Dec 19 13:17:47 1986. A comment to message 444.

I have the answer for you (it's on a disk I have in a program listing). So when I get off BIX, I'll list it out and report the answer here. (Not that I actually use DOS 3.3, mind you. I had to [he says, with this sour look on his face] when a client wanted a ProDOS and DOS 3.3 version of a utility I wrote. ProDOS is so much simpler with its "T" parameter...)

---

apple/software #447, from mdavis, Fri Dec 19 13:43:56 1986.

Assuming you have "normal" DOS in memory (not relocated to the language card or anything) the following POKEs will allow you to BLOAD any file.

```
POKE -23706, TYPE        POKE -23699, TYPE
```

where TYPE is one of the following values:

00	Text file
01	Integer BASIC program
02	Applesoft BASIC program
04	Binary file
08	Special "S" file
10	Relocatable "R" file
20	Special "A" file
40	Special "B" file

--Morgan

---

apple/software #448, from bill.p, Fri Dec 19 15:33:24 1986. A comment to message 447.

Okay, thanks for the info. I really appreciate it. Why do I need to know this for DOS 3.3, you ask? Because I am used to ProDOS and am unfamiliar with DOS 3.3, but a situation came up where I needed to make a program compatible with DOS 3.3 programs.

Don't worry, I am slowly but surely converting over to ProDOS....I just wish that more people would do the same so I would not have to remember so much stuff for BOTH DOS types; I just learn and become expert with one...

bill.p

---

apple/software #449, from bill.p, Fri Dec 19 15:34:52 1986. A comment to message 447.

The DOS 3.3 type I have loads itself into the language card area of RAM (Pronto DOS), so which memory locations do I poke now?

bill.p

---

apple/software #452, from mdavis, Sat Dec 20 14:07:19 1986. A comment to message 449.

continued



We designed our V.32 modem on the premise that speed is useless without reliability.

At Codex, we understand that all the speed in the world won't get you anywhere if you can't depend on it. And that's why we developed our V.32 modem to give you 9600 bps full-duplex dial transmission, rivalling the reliability of a dedicated leased line.

Admittedly a pretty big claim.

But then, it's really what you'd expect from the recognized leader in high speed modems. In fact, more data communications professionals prefer Codex than any other brand.* And it's our high speed modem expertise that has allowed us to make a modem that not only meets, but exceeds the V.32 standard.

Our V.32 modem uses the same VLSI technology and forward error correction scheme (Trellis Coded Modulation) as our high speed leased line modems that reliably transmit data up to 19,200 bps.

So, you can be sure of continuous high quality transmission over a wide range of line conditions. This now allows you to cut connect time and save money by sending data at up to 9600 bps full duplex over ordinary dial lines.

We've even added a proprietary long haul echo cancellation feature, eliminating both local and distant echoes that can plague dial networks. So even if the phone company sends your data over satellite links, it arrives intact.

Plus our V.32 modem includes a soft strap front panel, multiple ACUs, a nest card option for maximum space savings, and operates in synchronous or asynchronous applications.

To find out more about the Codex V.32 modem, call **1-800-426-1212,** Ext. 235. Or write Codex Corporation, Dept. 707-35, 7 Blue Hill River Road, Canton, MA 02021-1097. You'll discover that when we tell you about a V.32 with high speed performance and reliability, we're not blowing smoke.



codex
MOTOROLA

Visit us at Interface booth #1032, March 30–April 2.

*McGraw-Hill's *Data Communications* Brand Preference study cites Codex as offering the best technology, best price performance ratio, best service organization, and most informative literature for various modem, multiplexer and network control product categories. © 1986 Codex Corporation. Motorola and Ⓜ are trademarks of Motorola, Inc. Codex is a registered trademark of Codex Corporation.

Well, I would suggest, then, that you use normal DOS, make the pokes, and then use DDMOVER (or something similar that moves DOS to the language card) followed by a Master Create of your disk. That will at least allow you to make the changes and make them permanent on that one disk. Of course, that means whatever file type you poke for BLOADing will be the only one allowed.

It might be better to poke the following, if you don't care about any file type error handling:

```
POKE -23587,96          (RTS)
POKE -23586,234         (NOP)
POKE -23585,234         (NOP)
```

This will bypass the file type checking routine. This might be best if you're going to Master Create the disk (at least you can BLOAD any file that way).

I hate DOS 3.3.

THE CLOCK THROUGH PRODOS

[Message 377 picks up on a thread dealing with klutch's problems with his IIGS.]

---

apple/gs.other #377, from klutch (Bruce Klutchko), Tue Dec 2 20:39:07 1986. A comment to message 367.

... As it is, I am having trouble accessing the clock from ProDOS 1.1.1, and suspect that ProDOS-8 will be a help.

I do find the machine a tremendous improvement over my IIe's, as I love the keyboard and the ability to set the options on the control panel. My greatest problems are *not* Apple's doing, such as not being able to use my DOS 3.3 RAM disk software (on which I was totally dependent) for my AE Ramworks card. I may have to rewrite the software to ProDOS now. Also, I was very much dependent upon using an enhanced AppleWorks with the AE desktop expansion. I did buy V2.0, but as of yet, of course, this software isn't compatible. Therefore, I will still have to run my business on the IIe's in the office. But I suspect I will be spending much of my free time on the IIGS.

---

apple/gs.other #380, from robmoore (Rob Moore, Apple Computer Inc.), Wed Dec 3 04:47:32 1986. A comment to message 377.

ProDOS-8 will handle the clock for you. If your dealer calls his Apple distribution center, he should be able to get system disks. If he can't, then go to any other Apple dealer and make a copy if you want. I believe that AppleWorks 2.0 does expand the desktop in the GS. I'm not positive, though, because I don't use AppleWorks much. In any case, I hope this helps. Let me know if you have other questions.

---

apple/gs.other #385, from gs.softteam (Apple Computer Inc.), Wed Dec 3 13:43:45 1986. A comment to message 380.

The clock is implemented as a function under one of the tool sets (namely, the miscellaneous tool set). It does not appear in a slot, like the ThunderClock did. Nor does it place the time in page 2 locations as the ThunderClock did. Under ProDOS-8, the "get time" call will access the IIGS clock via the miscellaneous tools. APDA will be the earliest source of technical documentation and development software.
Ray Montagne (IIGS Software Team)

---

apple/gs.other #388, from mdavis (Morgan Davis), Wed Dec 3 19:27:50 1986. A comment to message 385.

ProDOS Tech Note #1 stated that the clock under ProDOS will deposit the ASCII time string into page 2. Now, under ProDOS-8, this won't happen. What was the rationale behind NOT making ProDOS-8 compatible? P16 is fine, but I would think that in order to avoid undue problems, Apple should have kept things compatible. We can't always trust tech notes now.

---

apple/gs.other #393, from gs.softteam, Thu Dec 4 12:38:51 1986. A comment to message 388.

The main compatability issue here is that the original clock (usually a ThunderClock) was implemented as a peripheral card. There were no additional slots available to do this.

Second, your statement asking the rationale of ProDOS-8 not being compatable with P16 is in error. ProDOS-8 has been modified to recognize when it is running in the IIGS and, thus, will use the IIGS clock when possible. ProDOS-8 running in an Apple IIe will still run with a ThunderClock.

ProDOS-16 actually has no call to read time. Since new (P16) applications will likely be running in the full native environment (16-bit), the application will have to make calls directly to the miscellaneous tool set and avoid the additional performance hit if the

continued

GANG, SET & UNIVERSAL (E)PROM PROGRAMMER

High Performance (E)PROM Programmer

Through years of dedication, BYTEK has achieved the ultimate in device programmers with the System 125. Compare FEATURES, Compare PRICE and you'll agree, **BYTEK** is the **#1 CHOICE** in (E)PROM Programming Equipment.

THREE PROGRAMMERS IN ONE:

- ☑ GANG EPROM Programmer: Support for MOS/CMOS EPROM/EEPROMs.
- ☑ SET EPROM Programmer: 16, 32 and optional 64-Bit Words
- ☑ UNIVERSAL Programmer: (Optional) Bipolar PROMs, Logic Array Devices, 40 pin Micro Computer Devices, 3 Voltage Devices, 8 and 16 Bit Emulation, and GANG adapter with additional 8 ZIF sockets.

STANDARD FEATURES:

- RAM: 64K BYTEs, (expandable to 1MBYTE)
- 3-Way Device Type Selection: Manually, Auto ID or from Menu
- Stand Alone Operation (includes DATA EDITing)
- 25 Key Integrated Keyboard, 32 Character LCD Display
- RS232 PC Interface for Terminal Mode
- Parallel Printer Port
- Computer Remote Control

ORDER TODAY:
800-523-1565
In FL: (305) 994-3520
Telex: 4998369 BYTEK

CA Sales Office:
(415) 487-4694



$1,495

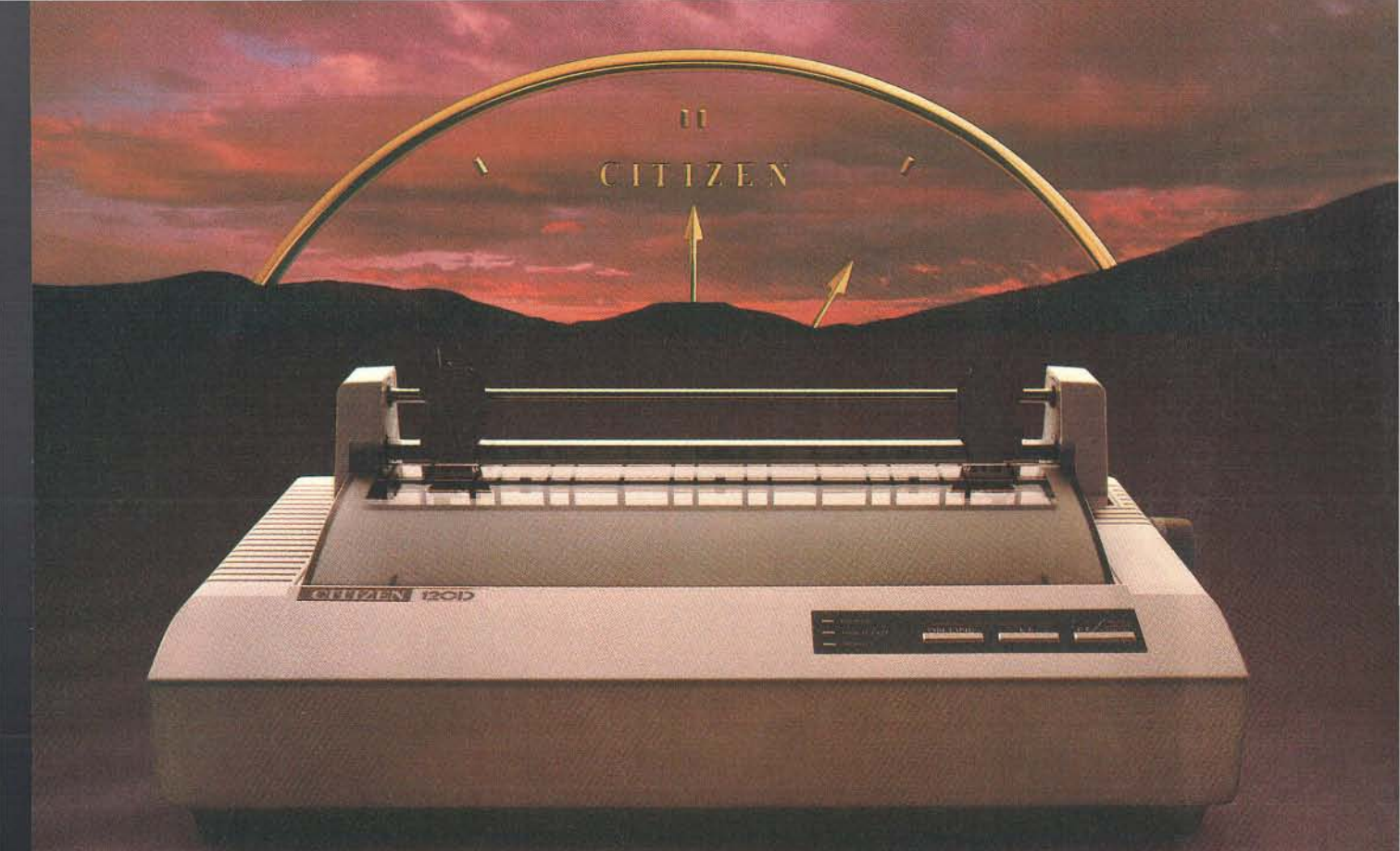
Model: S125-GL
Shown with optional PROMCel.
UV Erasers from $67

MADE IN THE U.S.A
DISTRIBUTOR INQUIRIES WELCOME

Mastercard or Visa Welcome

BYTEK Instrument Systems Division • 1021 South Rogers Circle • Boca Raton, Florida 33431

Inquiry 46



FOR PEOPLE WHO WANT MORE, BUT AREN'T WILLING TO PAY THE PRICE.

Citizen™ just took all the features of a high-end printer and made a small change.

We put them into a low-end printer. The Citizen 120D.

We created a dot matrix printer with more features and a lower price than any other printer in its class. One that produces clean, precise letters at a draft speed of 120 cps, with superior correspondence quality at 25 cps.

We added little extras, like a 4K-byte buffer, proportionally spaced printing, full graphics capabilities, and a unique paper loading system that's a small wonder. And we gave it the ability to survive the long run with most leading computer systems.

Because after 50 years of placing a world of precision on your wrist, we've come to realize something. Good things do come in small packages.

For more information, call 1-800-556-1234 Ext. 34. Or in California, call 1-800-441-2345 Ext. 34.

The Citizen 120D. Never has so much been offered to so many for so little.

©1986 Citizen America Corporation. Citizen and the Citizen logo are trademarks of Citizen Watch Company, Ltd.

CITIZEN™

Printers that run like clockwork.

Inquiry 55

call were to be made through P16. If P16 had implemented the time calls, then P16 would have ended up making the tool call. It's just faster to let the application do it itself.
Ray Montagne (IIGS Software Team)

---

apple/gs.other #394, from delton (Don Elton), Thu Dec 4 17:55:04 1986. A comment to message 393.

I think Morgan's point was that the ProDOS-8 GS clock driver doesn't put the date/time string at $200 like the ProDOS driver does on a IIe with a ThunderClock. Software that depends on the Apple-documented policy that all user clock drivers put the time date string in ASCII at $200 would thus fail on the IIGS because of the difference between the Apple software specs and the apparent performance of the Apple driver.

---

apple/gs.other #395, from mdavis, Thu Dec 4 18:41:42 1986. A comment to message 393.

You misread my message. What I said was, since ProDOS-16 cannot run on an Apple IIe, Apple IIc, or Apple II+, I felt as though the clock incompatibility was not an issue. However, since Apple made it clear in Tech Note #1 that you'll get an ASCII string of time data into page 2 whenever you use the "get time" call, I would have at least expected the 8-bit (ProDOS-8) to adhere to this in order to avoid problems for existing Apple II software being used on the GS in emulation mode. As it is, I now have to rewrite the clock routines in a few of my programs so that it will work correctly on the GS in emulation mode. It was nice having most of the work done for you; but now I'll have to unpack those damn date bytes (which isn't anything new to me) and write an algorithm to calculate the day of the week from that information, and so forth. My "time" routine will probably quadruple in size.

---

apple/gs.other #397, from gs.softteam, Thu Dec 4 20:06:32 1986. A comment to message 395.

ProDOS-8 supports the IIGS clock as the ProDOS "get time" ($82) mli call has always been documented. Applications executing "get time" receive the time in a hex format in the BF-hundred page ($BF90-$BF92). I don't have Tech Note #1 right now, but I think it describes installing a clock driver into ProDOS, and not how ProDOS returns the time. I will get a copy of the tech note and try to clear up any discrepancies. Stay tuned....
Ray Montagne (IIGS Software Team)

---

apple/gs.other #400, from mdavis, Fri Dec 5 03:58:47 1986. A comment to message 397.

You're partially correct. Tech Note #1 details the global page date bytes, but also discusses how you will get a string of ASCII characters into the input buffer whenever "get time" is executed.

Have I ever lied to you, Ray? :-)

BOOTING THE /RAM5 DISK

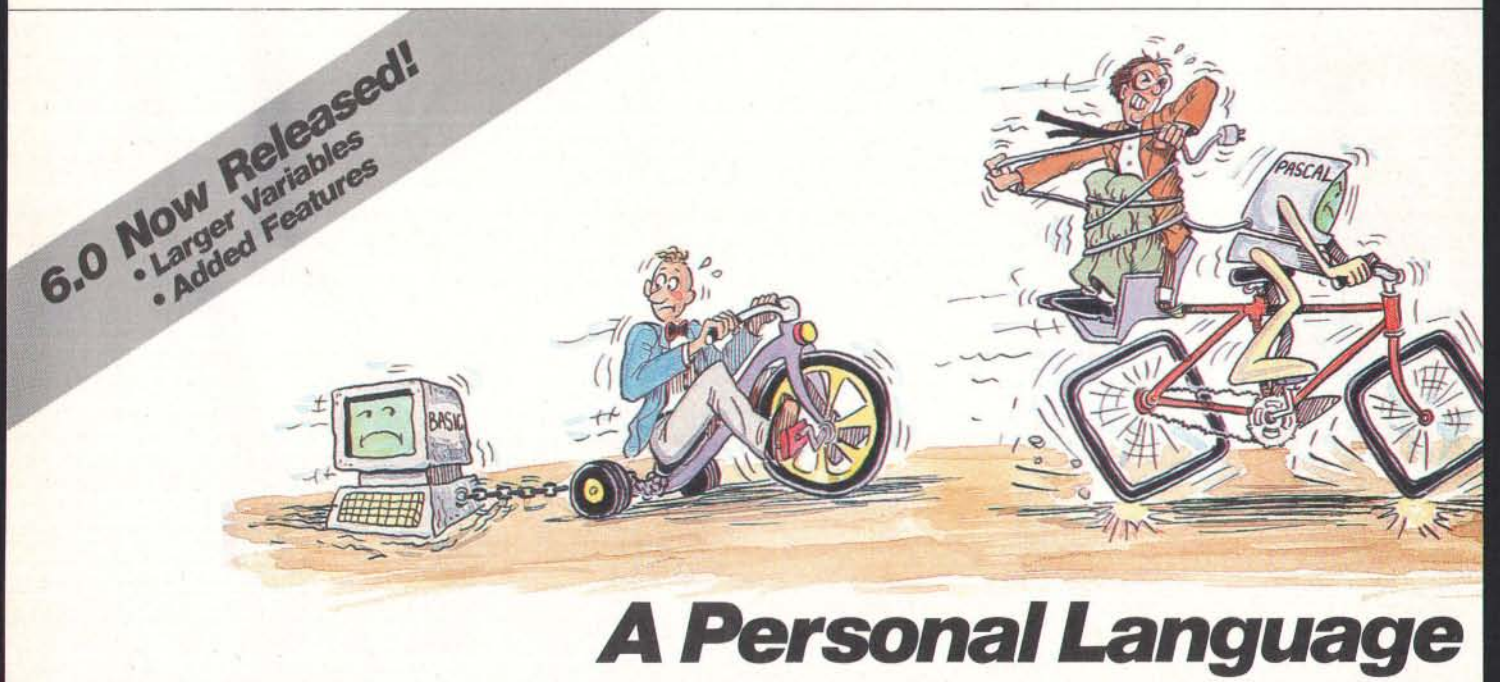
---

apple/gs.other #405, from mdavis, Sun Dec 7 03:58:12 1986.

Is there a set of commands that will let you "boot" /RAM5 as if it were a real disk-storage appendage on the GS? Since it's mapped to slot 5, drive 2 (or wherever, drive 2), can this be done? If not, is that just a limitation of ProDOS-8, or is it also true with ProDOS-16 (or with the hardware itself)?

---

apple/gs.other #406, from delton, Sun Dec 7 07:07:02 1986. A comment to message 405.



A Personal Language

When it comes to problem solving, the APL*PLUS System is the undisputed leader.

That's because the APL*PLUS System works with you. It goes far beyond what application software like Lotus® or dBASE® could possibly ever offer. And, it won't tie you down with the details of standard programming languages.

The APL*PLUS System is a personal language, with productivity features that help you concentrate on getting answers, rather than struggle with intricate calculations and modeling.

With it you can manipulate tables of numbers as easily as single numbers and get quick results from your computer using short, simple statements.

When you've reached the limits of other packages, move up to the APL*PLUS System. It's a powerful and flexible tool that grows with you as your needs become more sophisticated. With over 200 built-in applications—like graphics, report formatting and communications—you have all the tools at your fingertips to quickly and easily solve those seemingly impossible problems.

Best of all, the APL*PLUS System interfaces well with software packages you're already using—like databases, spreadsheets, and graphics packages. The APL*PLUS System also makes it easy to link those packages that aren't

You can boot from the RAM disk, slot 5. Go to the "slots" section of the control panel and keep hitting --> until "RAM disk" comes up. /RAM5 is still mapped to slot 5, drive 2, but it boots from there instead of the 3.5-inch disk in slot 5. You have to copy ProDOS onto the drive and a system program as you might expect and you probably have to use FILER first to format the disk (so boot code gets written). I haven't tried it without this latter step, since the Apple Memory Expansion card (slinky card) has this same requirement and it probably applies to the IIGS as well.

---

apple/gs.other #407, from delton, Sun Dec 7 07:07:46

There's also an option to boot from ROM disk but I don't know where that one tries to boot from.

---

apple/gs.other #408, from gs.softteam, Sun Dec 7 13:00:48 1986. A comment to message 406.

Close, but not quite. When you set the boot device to RAM Disk at reset, the RAM disk is assigned unit 1. The 3.5-inch drive that was unit 1 will be unit 2. The Apple IIGS works like all other Apple II products in that you can only boot from unit 1 in any given slot containing a block device.

In order to accomplish booting from various devices in slot 5, the assignment of unit numbers to devices is based on the control panel setting for the boot device. When set to boot off "Slot5" or "SCAN," booting will occur off the 3.5-inch drive closest to the computer (unit 1). When set to boot off the RAM Disk or the ROM disk, whichever of these devices is selected and installed will be assigned unit 1. A detailed explanation of device-mapping on slot 5 has already been offered on this forum, but I don't remember what message number. You may want to search for it.
Ray Montagne (IIGS Software Team)

---

apple/gs.other #409, from gs.softteam, Sun Dec 7 13:17:23 1986. A comment to message 408.

I found my previous explanation. See apple/gs.flames #287 for more information on SmartPort device mapping.
Ray Montagne (IIGS Software Team)

---

apple/gs.flames #287, from gs.softteam, Sun Nov 2 14:15:24 1986. A comment to message 284.

I have been waiting for this one to show up and was sure it would. If you count the number of devices supported on the IIGS and the number of internal slots, you see that there are more devices than slots.

```
[1] Serial port 1
[2] Serial port 2
[3] 80 column card
[4] Mouse
[5] SmartPort
[6] Disk ][
[7] AppleTalk
[8] RAM disk
[9] ROM disk
```

This being the case, the only way we could support the RAM disk and ROM disk was to logically insert these devices into the SmartPort device chain. Boot devices can only boot off the first device in any given port. When dealing with SmartPort, we have 3 bootable devices (Slot5, RAM Disk, and ROM Disk). In order to support booting off of any of the 3 different types of devices on SmartPort, the logical arrangement of devices has to change, depending on the boot configuration set in the control panel, so that the boot device is moved to the first device in the chain. SmartPort does this at boot time by assigning unit numbers to SmartPort devices in a two-stage process. First, unit numbers are assigned

continued



The APL★PLUS® System and You.

currently talking with each other.

With all this problem-solving power, it's no wonder STSC's APL★PLUS System is the personal choice of so many business professionals—financial planners, business analysts, actuaries, scientists, mathematicians, engineers, statisticians, and consultants. Especially since the APL★PLUS System is available on a full range of computers from desktops to mainframes.

Put the power, speed, and flexibility of the APL★PLUS System to work for you. See your local dealer today to get your APL★PLUS System. If they don't have it, refer them to STSC or call STSC toll-free, **(800) 592-0050.** In Maryland or Canada, **(301) 984-5123.**

Available nationally through Softsel, Micro Central, and distributors worldwide. Dealer inquiries welcome.

Problem-Solving at the Speed of Thought

STSC STSC, Inc.
2115 East Jefferson St.
Rockville, MD 20852

APL★PLUS is a service mark and trademark of STSC, Inc. PLUS★WARE is a trademark of STSC, Inc. Lotus and dBASE are registered trademarks of Lotus Development Corporation and Ashton-Tate, respectively.

A PLUS★WARE™ PRODUCT

Inquiry 354

©1986 STSC, Inc.

in ascending order, starting with the RAM disk, ROM disk, and then the SmartPort devices such as AppleDisk 3.5 & UniDisk3.5. Once all devices have had their unit numbers assigned, the second-stage assignment takes place. During the second stage, the boot device is moved to unit 1 (the first device on the chain) and all devices that were ahead of the boot device in the first-stage assignment are moved behind that device in the second-stage assignment. This is how your device list in ProDOS can appear different for various boot configurations. ProDOS 1.1.1 only supports two devices per slot. When using a RAM Disk and two 3.5-inch disk drives with slot 5 set as the boot device (or scan, for that matter), the first physically connected 3.5-inch drive will be unit 1, the RAM Disk will be unit 2, and the second physically connected 3.5-inch disk drive will be unit 3. Since ProDOS 1.1.1 only supports 2 devices per slot, one of the devices will be lost. But, alas, we anticipated your frustration and mapped the second two SmartPort devices into slot 2 when using ProDOS-8. This means that with ProDOS-8 your second 3.5-inch drive would appear in slot 2, drive 1 of the ProDOS device list. You can recover lost devices on ProDOS 1.1.1 applications by copying ProDOS-8 onto that disk. ProDOS-16 will recognize SmartPort devices and will list all SmartPort devices as slot 5 with the appropriate unit number.

I hope this explains the missing device problem. It has been pretty confusing to most everyone at Apple, too.
Ray Montagne (IIGS Software Team)

---

apple/gs.other #410, from mdavis, Mon Dec 8 01:26:03 1986. A comment to message 406.

> Go to the "slots" section...and keep hitting -->
>until "RAM disk" comes up.

Yeah, yeah, yeah....and then what? (I don't have a GS in front of me, so I can't visualize the rest of the procedure.)

While at Jerry's place a few days ago, we used UniCopy to move an entire 3.5-inch disk to /RAM5 for booting and using from there. Much faster, of course, than the AppleDisk 3.5. Rather than 44 seconds to boot P16, it takes less than half that time.

---

apple/gs.other #412, from delton, Mon Dec 8 19:18:52 1986. A comment to message 410.

Okay, after "RAM disk" comes up as the startup slot, you hit return to accept and then move to the quit bar to get out of the control panel. Next time you boot, the system will boot from /RAM5 instead of whatever was previously set up.

BASIC

Topics in this excerpt include the degree of support for windows and mouse devices in QuickBASIC 2.0 and Turbo BASIC, and solutions to a variety of programming problems.

WINDOWS AND MICE IN BASIC

---

basic/newbasics #406, from shalom (Sholom Hamada), Sat Dec 27 21:19:56 1986.

I have a question about Microsoft's QuickBASIC and Borland's upcoming Turbo BASIC. Why won't they implement some windowing and mouse commands in BASIC proper? Microsoft BASIC for the Mac contains such commands as MENU (to create and interface with pull-down menus), mouse functions (to get mouse coordinates and values), DIALOG (to create and interact with dialog boxes), WINDOW (to open actual windows, not just to redefine x,y coordinates), EDIT FIELD, etc, etc. If it can be done for the Mac, why not for the PC?

I assume, of course, that these commands need interfacing to some windowing system. Well then, why can't QuickBASIC interface to Microsoft's own Windows? And if Borland could create such a sophisticated user interface for *developing* TurboBASIC programs, then why can't they allow BASIC programs to utilize those facilities?

Is there some difficulty in implementing this that I'm not aware of? Is there some company that sells QuickBASIC code for doing these things? Is there some way of interfacing these BASICs to Windows, GEM, etc?

---

basic/newbasics #407, from btonkin (Bruce Tonkin), Sat Dec 27 22:00:32 1986. A comment to message 406.

I can only offer my suspicions concerning these questions, but I think they're probably reasonably close.

1. Windowing techniques are pretty difficult to write without making some assumptions about the hardware. So, if you want a general-purpose access to windowing environments, it's going to mean a fairly hefty library. Now: QB sells for $99, and TB will sell for $99.95. I'll bet those libraries could be sold for more than the $99, all by themselves. Certainly, the MS C package with links to Windows sells for about $400.

2. MS and Borland are both assuming (probably incorrectly - certainly incorrectly in my case) that developers aren't going to use BASIC, but C or Pascal. So, windows is offered on those languages and not on BASIC.

3. Windows support under BASIC would mean a different calling convention than for C. The parameters are passed in a different order. That would mean either changing BASIC or having a different version of windows for BASIC developers, with twice the support requirements as for the current package.

4. How much of a market is there for windowing environments? Is there enough of one to go beyond the support furnished in C? MS may hope that Windows catches on in the MS-DOS market, but I see no signs that it has, or will ever do so. If it does, fine; you can bet MS will support it on all their products, one way or another. If it doesn't, or until it does, why commit resources to it beyond what is currently in place?

You may guess from my comments that I don't think much of windowing environments. You'd be right. My impression is that they demand a great deal of overhead, a faster processor than is present in most current micros, and a lot of work to get going correctly. My personal opinion is that they offer nothing to the user and should be avoided whenever and wherever possible, but that's just my PERSONAL opinion. My impressions (as opposed to my opinions) are fairly widely held in the industry.

There are, of course, a few misguided souls who disagree with my opinions. :-)

---

basic/newbasics #408, from lkraft (Larry Kraft, Borland International), Sun Dec 28 02:11:22 1986. A comment to message 407.

As we did with Turbo Pascal, Turbo BASIC will have a wide range of source-code Toolboxes that will give you additional program capabilities. There are add-on products for BASIC. One company is Crescent Software in Connecticut. Ethan Winer has a BIX account, so you might get ahold of him.

EGA SCREEN DUMPS

---

basic/programming #305, from jhuguenard (John Huguenard), Tue Dec 9 00:50:20 1986.

continued

Why Do They Look So Different But Cost About The Same?

This is Toshiba 24 pin letter quality.

This is 9 pin printer quality.

When we developed the P321 and P341e 3-In-One™ dot matrix printers, we had just two goals in mind.

Superb 24-pin letter-quality reproduction. And a price that's as close as possible to standard 9-pin models.

One look at the print sample shows you we succeeded. So will one look at the price.

In fact, we were so successful, we gave these 24-pin printers with the 9-pin price a special name: *The Affordable Class.*

And we included features—starting with type font cartridge capability—that put them in a class by themselves.

Both the Toshiba P321 and P341e printers produce letter-quality documents at 72 CPS, drafts at 216 CPS and high-resolution graphics at 180 x 360 dpi.

Each printer has our industry-standard P351 command set for more sophisticated word processing and high-resolution graphics.

And each printer has standard application compatibility with the entire IBM PC[1] line of products.

Options include downloadable disk capability and type font cartridges for an unlimited range of type styles, a one- or two-bin sheet feeder as well as continuous forms tractor feeder.

The affordable and compact P321: If you're keeping an eye on the bottom line, we'd like to direct your attention to our P321. When it comes to virtually all business and correspondence needs, it fills the bill nicely.

You get letter-quality reproduction in a printer that looks great on the bottom line.

The affordable extended-carriage P341e: If you need to do full-size spreadsheets, you need our wide-carriage P341e.

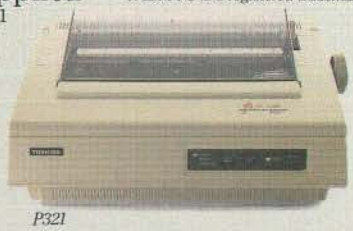
Like the P321, the P341e uses our 24-pin printhead that lasts up to four times longer than other printheads, and has made us the number one seller in the business.

So buy a Toshiba Affordable Class P321 or P341e printer today.

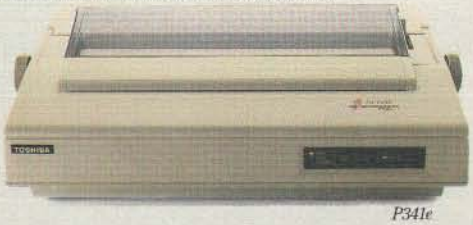
You'll get letters that look perfect every time at no extra cost.

For the Toshiba printer and computer dealer nearest you, call 1-800-457-7777.

1. IBM PC is a registered trademark of International Business Machines Corporation.



P321



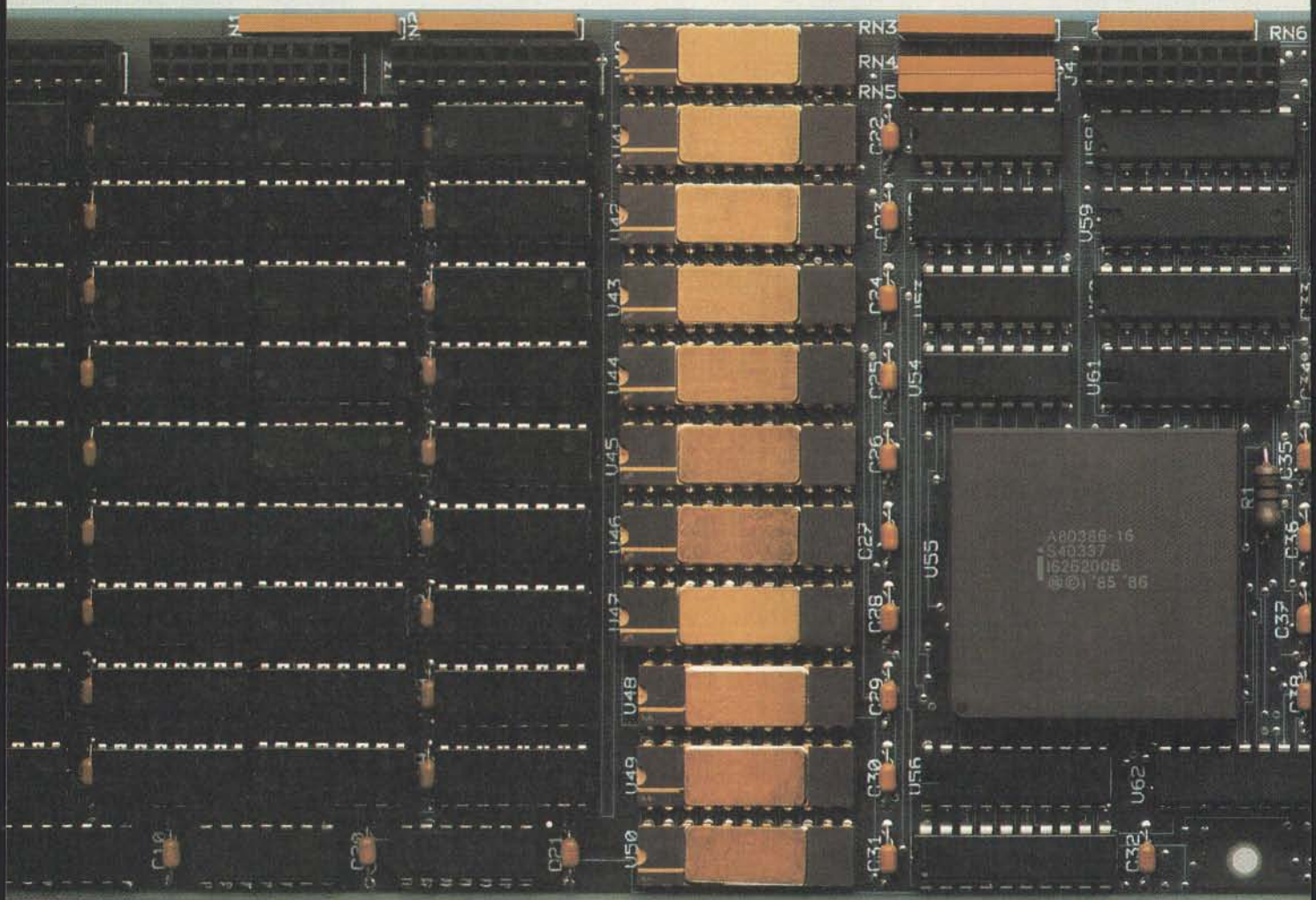
P341e

In Touch with Tomorrow

TOSHIBA

Toshiba America, Inc., Information Systems Division

How to 386



It's simple.

With Intel's Inboard™ 386/AT.

It fits right into your IBM® AT or compatible, and gives you all the performance of a 386 system.

Without having to buy a 386 system. (Which, if you've priced one lately, is about three times as expensive.)

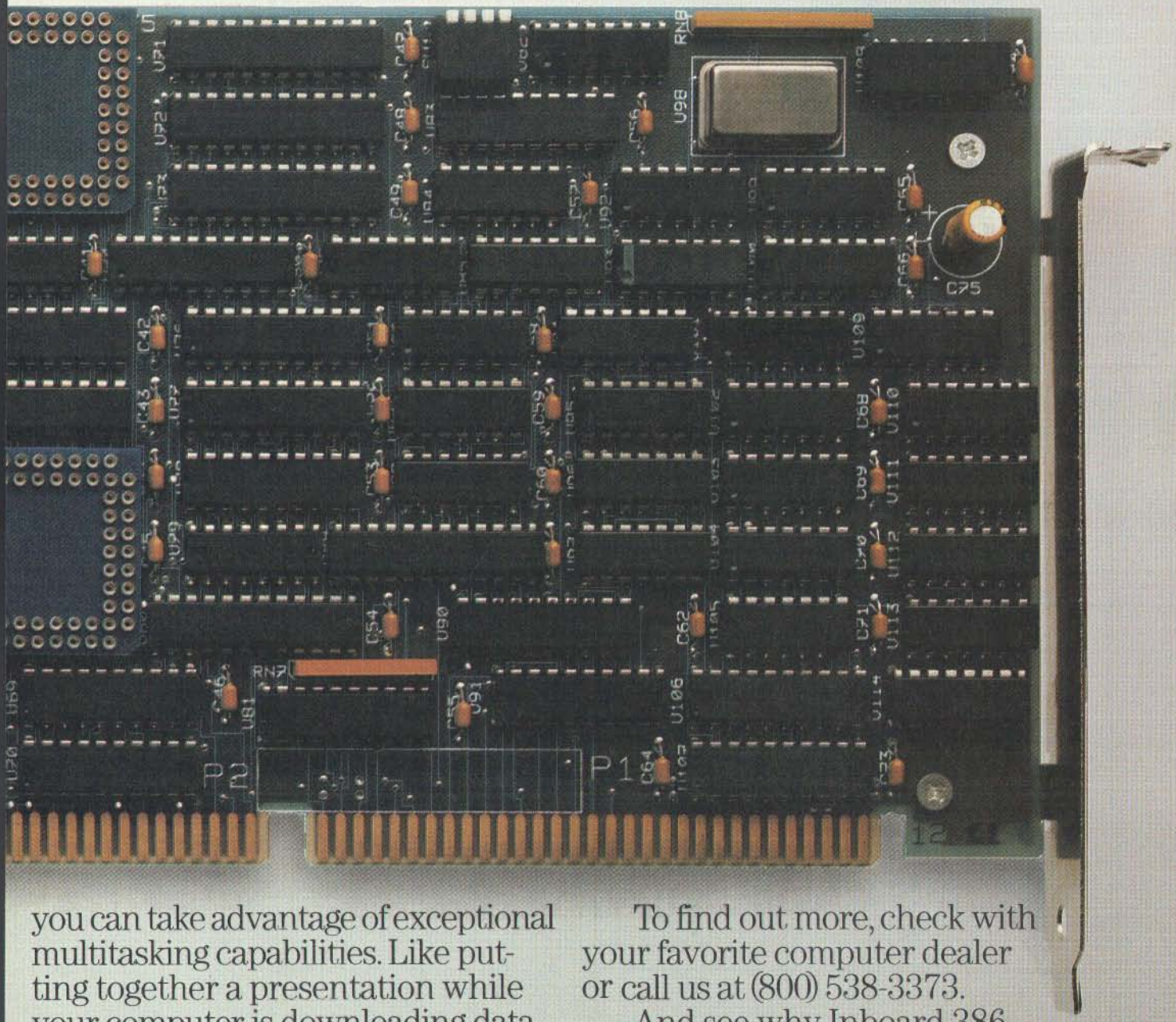
Inboard 386 is based on the revolutionary 32-bit, 16 MHz 80386 chip *we* invented. So it'll work with all the software you've got sitting on your desk. As well as any add-in boards you may have hiding in your computer—like, just for instance, the Above™ Board. Which we also invented.

Inboard 386 lets you whiz through recalcs with Lotus® 1-2-3.® And it makes your network server serve you even faster. In fact, it'll make any program serve you faster.

And with 386 control software,

Inboard and Above are trademarks and Intel a registered trademark of Intel Corporation. IBM is a registered trademark of International Business Machines Corp. Lotus and

your AT.



you can take advantage of exceptional multitasking capabilities. Like putting together a presentation while your computer is downloading data. (A slightly more efficient way of doing business.)

Don't forget our five-year warranty. Or toll-free technical support line.

To find out more, check with your favorite computer dealer or call us at (800) 538-3373.

And see why Inboard 386 beats the system.

intel®

1-2-3 are registered trademarks of Lotus Development Corp. © 1986 Intel Corporation

Inquiry 367

Inquiry 82 for End-Users.
Inquiry 83 for DEALERS ONLY.

It's Time To Switch Boxes

NEW SLIM DESIGN and a LIFETIME WARRANTY . . .

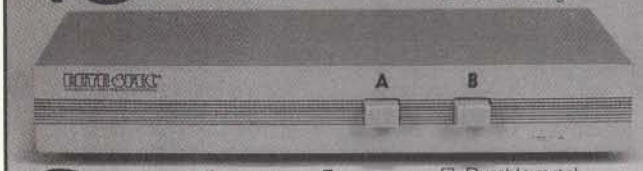
Two great reasons to make the switch.

Only 1½" high, but still with the same high quality features you have come to expect from DATA SPEC Switch Boxes:

- ☐ Reinforced printed circuit boards
- ☐ Full shielding
- ☐ Durable metal construction
- ☐ Gold-plated contacts
- ☐ All pins switched

And now, backed by a lifetime warranty.

Visit your local DATA SPEC dealer and see our full line of slim style data switch boxes and other computer accessories.



DATA SPEC
A DIVISION OF ALLIANCE RESEARCH CORPORATION
THE ULTIMATE IN COMPUTER ACCESSORIES

20120 Plummer Street • P.O. Box 4029 • Chatsworth, CA 91313 • (818) 993-1202

In Japan: Call Data Spec Japan LTD., Tokyo, Japan, Tel. (03) 774-7741

FIGURE IT OUT FOR YOURSELF

If you can figure out this puzzle, you may be able to qualify to join MENSA, the society for people whose intelligence is at or above the 98th percentile on a standard "IQ" test.

Below are four views of the same alphabet block, which has a different letter on each of its six faces. What is the missing letter in view D?



TO: MENSA 2626 East 14th St.
Dept BY87, Brooklyn, NY 11235

- ☐ Send brochure, telling how I may already have qualified.
- ☐ I'll take the at-home test. Enclosed is $9.00 (Check or money order in U.S. funds, only, please).

Name _____
Address _____
City/State/Zip _____

Answer V

I need help again on my current program. Two problems: 1) Is there a public domain program (utility) that will allow EGA graphics screen dump to an IBM graphics printer or equivalent? 2) Is there a way to chain to a nonBASIC (QuickBASIC in this case) .EXE or .COM file (e.g., a Turbo Pascal program)?

---

basic/programming #306, from dmick (Dan Mick), Tue Dec 9 01:04:45 1986. A comment to message 305.

You can't *chain* to a non-BASIC program, but you can "RUN" or "SHELL" it. No help on the first one, though.

---

basic/programming #307, from barryn (Barry Nance), Tue Dec 9 01:11:49 1986. A comment to message 305.

There's a public domain "Print Screen" program in the Listings conference. It's in the ibm.lib area, and it's called "prtsc.lqr". It contains source code, .doc, and .com files for a print-screen TSR program that is designed for Okidata 92/93 printers *without* the IBM-compatible Plug-'N-Play kit.

I'm sure you can modify it to do EGA graphics on an IBM printer, if you know a little assembler.

FINANCIAL CALCULATIONS

---

basic/programming #201, from alf (Eric Klein), Wed Dec 3 10:22:18 1986

I need to find the annual percentage gain based on the initial price, the final price, and the amount of time that has passed by. For example, something that was worth $100 two years ago and is worth $121 today would have an annual percentage gain of 10 percent. $100 * 1.1 * 1.1 = $121. Does anyone know the correct formula? Eric Klien

Note: The answer lies in a BASIC finance program that is provided with Apple II computers. (Or, at least, used to be.) Unfortunately, I no longer have this program.

---

basic/programming #302, from btonkin, Wed Dec 3 23:21:34 1986. A comment to message 301.

It all depends on how often you're compounding. The answer to your question would come from a little subroutine that looked like this:

```
X=FINAL/INITIAL RATE=100*((X(1/PERIODS))-1) RETURN
```

where "final" is the final valuation, "initial" is the initial valuation, "periods" is the time period over which interest is to be calculated, and "rate" is the interest rate per period (normally, per year). This calculation implicitly assumes that interest is continuously compounded and would have to be altered if the interest would be compounded at fixed intervals (quarterly, monthly, semi-annually, or annually). In that case, the formula would be more complex.

If accuracy is important, I suggest all variables be made double-precision.

PASCAL

This month's excerpts include questions about data file integrity and security using Turbo Pascal, and a discussion of writing to the lower right corner of the screen without scrolling.

continued



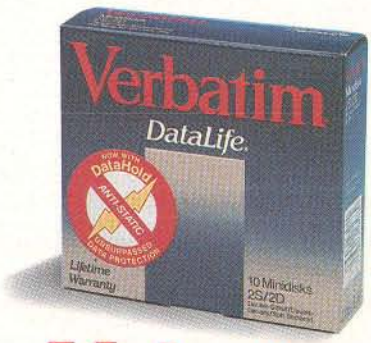
Problem: Mysterious Data Loss
Solution: New Verbatim DataHold Protects when Static Strikes.

Static Danger is Everywhere. Your data is vulnerable to loss from an unseen enemy—static electricity! Even small static charges could cause sudden mysterious data loss from your diskette.

And static lurks everywhere. Just walk across a carpeted floor and you build up a static charge of up to 1,500 volts—enough to ZAP your data.

It's DataHold or Data Loss. DataHold is Verbatim's ingenious diskette liner that disperses damaging static charges instantly. Compare DataLife to other popular brands which retain static charges up to four minutes and your choice should be obvious.

DataHold, available exclusively from Verbatim DataLife, for unsurpassed data protection. After all, it's your choice, DataHold or data loss.



Verbatim®
A Kodak Company

Verbatim • 1200 W.T. Harris Blvd. • Charlotte, N.C. 28213 • 800-538-1793

Inquiry 322

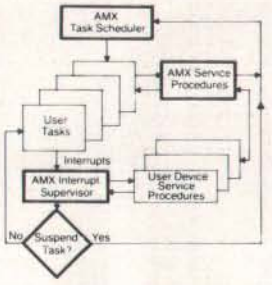
8080
Z80
6809

AMX

8086
8088
Now
68000

Real-Time Multitasking Executive

- No royalties
- Source code included
- Fault free operation
- Ideal for process control
- Timing control provided
- Low interrupt overhead
- Inter-task messages



AMX is TM of KADAK Products Ltd.
CP/M-80 is TM of Digital Research Corp.
IBM, PC DOS are TM of IBM Corp.

Options:

- Resource Manager
- Buffer Manager
- Integer Math Library
- Language Interfaces: C, Pascal, PL/M, Fortran
- DOS File Access: CP/M-80, IBM PC DOS

AMX for 8080	$ 800 US
8086	950
6809	950
68000	1600
Manual (specify processor)	75

KADAK Products Ltd.
(604) 734-2796
Telex: 04-55670
206-1847 W. Broadway, Vancouver, B.C., Canada V6J 1Y5

Customize Your Keyboard



- Eliminate Confusion
- Reduce Training Time
- Increase Productivity

Need Custom Keytops?
Call us at 602 634-7515



Hooleon CORPORATION
P. O. Box 201, Dept. BY,
Cornville, AZ 86325

KEYTOPS—Kits to support most software, including:

___PC to 5251	$21.95	___DisplayWrite 3	$21.95
___PC to 5520	$29.95	___WordPerfect 4.1	$29.95

KEY EXPANDERS Touchdown™ key expanders enlarge small, critical keys (Return, Shift, Backspace, etc.) on the IBM PC and look-alikes to full-size, AT-style keys. Full kit has 12 separate expanders. Mini-Kit: Enter/Ret, both shifts, backspace. All kits support LED where needed. Must specify keyboard.

___FULL KIT $21.95
___MINI KIT $10.95
☐ Black ☐ Gray

Language conversions available! ☐ Send me FREE INFORMATION

Specify Keyboard Make/Model: _____
Name _____
Address _____
City, St, Zip _____
☐ VISA ☐ MC # _____ Exp. _____
Visa or MC orders: **602 634-7515** Same Day Shipment • U.S. Postage Paid

FILE SECURITY TECHNIQUES

pascal/turbo #2283, from prez (Pres Tuesley), Sat Dec 13 12:48:11 1986.

I have an application written in TP that calls up a remote database, transmits some information to it (one "record" at a time), and gets back updated information. I am having problems with line noise and other glitches confusing the program and causing it to lock up or crash. Until I make this program bulletproof, how can I insure the integrity of the disk file I am saving this info to? I find that if the program crashes without closing the file, the directory doesn't get updated and ALL of my information is lost. I understand that I can close the file after every entry is added, but this is also VERY slow (I have been told). Since I am using Concurrent DOS (nee Concurrent CP/M), I don't have the ability to duplicate my file handle and close that, like MS-DOS can. Has anyone out there solved this problem before?

pascal/turbo #2284, from bbrown (Bob Brown), Sat Dec 13 13:00:50 1986. A comment to message 2283.

Pres, what's the load like on the database end? And how long does it take to send a record? If you're the only user, or if the machine is lightly loaded, and if you can overlap (buffer) your communications, then it might not make any difference that closing and reopening a file is a time-consuming operation. If closing/opening takes less time than sending the next record, it's invisible to the remote (sending) end. You probably also want to put a checksum on each record and reject those where the checksum doesn't match when the record gets to the other end. There's a telecommunications conference on BIX where a lot of this kind of stuff is discussed, but I'm not a member, so I can't point you to the right area. You might want to just wander over there and ask your question again.

pascal/turbo #2289, from jimkeo (Jim Keohane), Sat Dec 13 13:34:41 1986. A comment to message 2284.

Pres, the receiving program should be able to detect loss-of-carrier, or garbage-on-line, or time-out, and then close the file at that point. The garbage-on-line condition can be detected by some simple protocol, like a checksum, appended to each transmission. If the checksum does not match what was received, you *might* want to have the recieving program request that the transmission be repeated. After a number of unsuccessful retries, assume it's hopeless and close the file. - Jim

pascal/turbo #2290, from barryn, Sat Dec 13 13:59:42 1986. A comment to message 2283.

I think a good, fast, CRC-based protocol is what you need. Want one already coded in Turbo? Join the pc.bix conference, look at the read.me topic to see which message in the source.code topic is the BIXMODEM.INC file (I forget which it is), and then capture that message from the source.code topic.

[Editor's note—*BIXMODEM.INC, copyrighted by Barry Nance, is almost 10K bytes long, too long to print here. Barry has, however, granted permission for us to include it on BYTEnet Listings (see page 4) and on this issue's listings disk (see insert card following page 352).*]

WRITING TO THE LOWER RIGHT CORNER

pascal/turbo #2291, from bbrown, Sat Dec 13 22:50:23 1986.

If you (read I!) use WRITE (not WriteLn) to put a character in the bottom right corner of the screen, or a window set with the Window procedure, the screen or window rolls up. Is there a way to avoid that?

continued

Inquiry 135 for End-Users.
Inquiry 136 for DEALERS ONLY.

WHERE



THERE:

From the United States you can call just about anywhere in the world through the vast, reliable AT&T Long Distance Network.

So, whether you're doing business near the corn fields of Kansas or the rocky coast of Maine, the AT&T Long Distance Network is virtually as close as the nearest phone.

And, you can always count on the nationwide AT&T Long Distance Network's quality service. Providing you with full service AT&T long distance operators ready to help place calls or give credit for misdialed long distance numbers.

And, whether you're traveling around the country or to many foreign locations, it's reassuring to know you have the AT&T Card.

Use the AT&T Card to plug into the AT&T Long Distance Network. To order your AT&T Card today, simply dial

1 800 CALL ATT, Ext. 229.

AT&T

The right choice.

© 1986 AT&T

SWITCHING POWER SUPPLY

①For PC-AT 220W



③For PC-XT 135W, 155W



②For BABY AT 200W





④For TV GAME a.+5V/7A, +12V/1A, −5V/1A
b.+5V/10A, +12V/1A, −5V/1A



CYE

CHUNG YU ELECTRONICS CO., LTD.
P.O.BOX 30-535 TAIPEI, TAIWAN, R.O.C.
FAX, 002-886-2-3971968 TLX,24451 CYELEC
TEL, 002-886-2-3918100, 3414596

UNITED STATES BANKRUPTCY COURT
DISTRICT OF MASSACHUSETTS

In re	)	
SUPPRESSION DEVICES CORP. f/k/a ELECTRONIC PROTECTION DEVICES, INC.,	)	No. 84-681-JG (Chapter 11)
Debtor	)	

NOTICE OF ORDER ESTABLISHING
BAR DATES FOR WARRANTY CLAIMS

PLEASE TAKE NOTICE that an Order Barring Warranty Claims and Providing for Notice of Same has been entered and pursuant to said Order:

1. That, except as otherwise specifically provided in this Notice, any and all claims by any person or entity ("Claimant") against Debtor (i) arising from any warranty express or implied of products sold by Debtor to anyone prior to February 20, 1985 ("Debtor's Products"), and (ii) regardless of *when* or *whether* Claimant *purchased* the given item of Debtor's Products directly from Debtor or from some other vendor (the "Warranty Claims"), are forever barred and may not be the subject of any action in this or any other forum.

2. That Claimant may select either Option A or Option B below (but not both), and selection of one Option shall operate as an irrevocable bar to invocation of the other Option:

OPTION A

If Claimant wishes to preserve whatever rights it may have to obtain any one or more of the following remedies (the "Normal Course Remedies"): (i) repair; (ii) replacement; (iii) payment or other value (as by repair of computer equipment damaged by failure of Debtor's Products) of up to a maximum amount of $2,500 for each Warranty Claim under Debtor's performance warranty, Claimant *must* deliver written notice of its Warranty Claim with proof of actual damages to Electronic Protection Devices, Inc., a Delaware corporation, 35 Dunham Road, Billerica, Massachusetts 01821 ("EPD-Del"), so that such written notice and proof are *received* by EPD-Del at the foregoing address *before* 5:00 p.m., EDT, June 30, 1987.

OPTION B

If Claimant wishes to preserve whatever rights it may have to obtain any form of relief other than the Normal Course Remedies specified in Option A, Claimant must file a proof of claim against the Debtor *before* 5:00 p.m., EDT, April 15, 1987 with Clerk, United States Bankruptcy Court, 1101 Boston Federal Office Building, 10 Causeway Street, Boston, MA 02222-1704.

3. That nothing in this Notice shall be deemed to constitute EPD-Del as, or to imply that EPD-Del is, a successor to the Debtor generally responsible for Debtor's liabilities. EPD-Del is hereby assuming no debts, liabilities or other obligations of Debtor other than Warranty Claims seeking the Normal Course Remedies set out in Option A above.

Debtor estimates that on or before March 31, 1985, end users had purchased more than 95 percent of Debtor's Products (which are not to be confused with those products that have been sold or are being sold now by the Delaware corporation known as Electronic Protection Devices, Inc., and referred to herein as EPD-Del). Any purchaser who believes he purchased one of Debtor's Products and may thereby be affected by said Order is urged to respond to this Notice regardless of the date of his purchase. For further information, call or write Debtor's attorney, Peter Nils Baylor, Esq., Nutter, McClennen & Fish, 600 Atlantic Avenue, Boston, MA 02210, phone (617) 973-9700.

pascal/turbo #2292, from dondumitru (Donald Dumitru), Sat Dec 13 23:18:42 1986. A comment to message 2291.

What is happening is this: The Turbo Write and WriteLn procs use the BIOS TTY-Write function for their output. The problem is in the BIOS routine. The only way around it involves using a different system for screen writes. You could create your own user-written I/O driver for ConOut. See page 209 in the TP manual. You would need to do your own handling for the cursor. (Does all this make sense, or do I need to go into more detail?)

P.S. It is certainly possible to handle the bottom right corner as a special case - hmmm.

pascal/turbo #2293, from barryn, Sat Dec 13 23:23:52 1986. A comment to message 2292.

I think you're on to something, Don. If only a certain message from a program can ever appear on line 25 (and cause the scroll when it "touches" column 80), then maybe something besides Write() should be used to put that message on the screen in that location. Use Write() for everything else, but do something special for the bottom right corner.

pascal/turbo #2294, from dondumitru, Sun Dec 14 09:56:08 1986. A comment to message 2293.

Actually, I was thinking that you install a new ConOut, in which you look at where the character will be printed. If it is in the bottom right corner, then use the BIOS Write-Character/Attribute-at-Cursor-Position routine; otherwise, use the TTY-Write routine. Now that I think about it, I'm not so sure that Turbo *does* use the TTY-Write routine. TTY-Write doesn't let you give it an attribute; it uses the attribute that is already in that cursor position. Ack. Anybody brave enough to go trace through it? I guess I am...

But yes - if possible, the best choice is to use some other screen-writing technique for the last line only. (Assuming it is reasonable....) Could we have some more info on the application?

pascal/turbo #2297, from dondumitru, Sun Dec 14 10:32:52 1986. A comment to message 2294.

Well, I *was* wrong when I said Turbo used TTY-Write. It uses BIOS call INT 10h, AH=09h (Write Attribute/Character at Cursor Position). Turbo does all the cursor positioning itself. What happens is this: It writes a character, then positions the cursor to the position after the written character. Then, if the cursor is beyond column 80 (or whatever the installed width is), it increments the cursor row. Then, if the row is beyond row 25, it scrolls the screen. Using the normal Turbo Write routines, there is no way to avoid the scroll. You need to use something else to write to that last character position. (Probably a simple BIOS Write-Attribute/Character-at-Cursor-Position thingy, but don't scroll the video. And make sure you put the cursor back somewhere believable, or Turbo may get lost. And if you are using windows, you need to be even more careful...)

pascal/turbo #2298, from bbrown, Sun Dec 14 10:37:38 1986. A comment to message 2297.

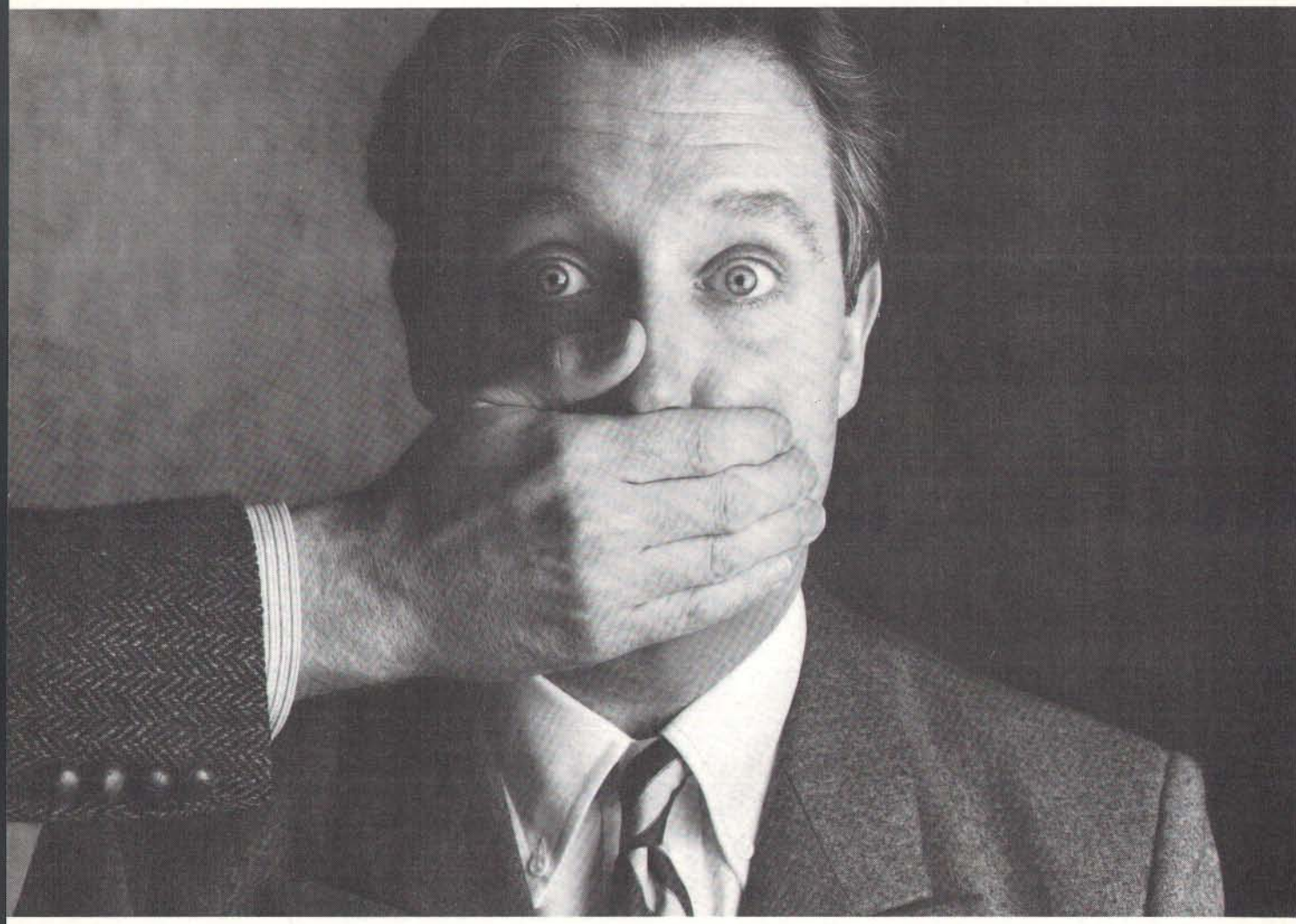
Don, thanks for the detective work! I'm still in the design-the-external-interface stage of this project; I think I'll just try to avoid the last byte in each window. Since I know now that it's necessary, I can pro'ly do it.

pascal/turbo #2299, from dondumitru, Sun Dec 14 11:15:27 1986. A comment to message 2298.

Now just a minute! Before you go avoiding the last byte in the display, take a look at this little gem. It solves the problem...

continued

THE MAKERS OF VTERM/220 ARE PLEASED TO ANNOUNCE THE FOLLOWING COMPANIES HAVE CHOSEN OUR DEC TERMINAL EMULATION SOFTWARE.



Among our largest customers are ~~General Electric, Westinghouse, Bankers Trust, Irving Development Corp., Exxon.~~ And the ~~U.S. Department of the Navy.~~

Big institutions can be very close-mouthed about the competitive edge they get from a powerful tool like VTERM/220. So while they'd prefer that we not name names, we can still tell you the reasons why we have more satisfied users than all our competition combined.

First of all, giant institutions don't stay giant by being sloppy. They spec things down to a gnat's eyebrow. That's why we're proud to say that VTERM's biggest fans are large corporate, scientific and government installations that perform very serious evaluations of communications software. They give VTERM the highest praise for accuracy of emulation, ease of use, multiplicity of features, speed of execution, and just plain quality.

Just look at VTERM/220's outstanding features:

- Plug compatible VT220 and VT100 video and keyboard emulation with customizable key mappings.
- Powerful file transfer including the most thorough implementation of KERMIT available on the PC, plus XMODEM, and our proprietary protocol VTRANS with complete host-side software for VMS,™ RSTS/E,™RSX11 M/M+ ™ and UNIX.™
- Host data capture and conversion to Lotus® 1-2-3,® Symphony® and dBase.®
- 132-column display via horizontal scrolling or optional video board.
- Scrollback buffer for redisplay of up to 2,000 lines (eighty screens!).
- "Hot Key" toggle between host session and PC DOS.
- Programmable softkeys with script-like capabilities.
- Full support for multinational and national character sets.

VTERM/220 is not the only thing we have to talk about. There's also our VT100 emulator VTERM III, and our Tektronix™ 4010/4014 graphics emulator, VTERM/4010. Both of these VTERM's have a lot of the power of VTERM/220, including file transfer.

So if you're looking for terrific terminal emulation programs for your IBM PC or other compatible computers, you and 50,000 other users have found it at Coefficient. We're the leader in DEC Emulation Software. Just ask AT & oops.

Call us today at 212- 777-6707 ext. 405.

Coefficient

Coefficient Systems Corporation
611 Broadway, New York, N.Y. 10012



The Amazing A-BUS

NEW



An A-BUS system with two Motherboards
A-BUS adapter (IBM) in foreground

Plug into the future

With the A-BUS you can plug your PC (IBM, Apple, TRS-80) into a future of exciting new applications in the fields of control, monitoring, automation, sensing, robotics, etc.

Alpha's modular A-BUS offers a proven method to build your "custom" system today. Tomorrow, when you are ready to take another step, you will be able to add more functions. This is ideal for first time experimenting and teaching.

A-BUS control can be entirely done in simple BASIC or Pascal, and no knowledge of electronics is required!

An A-BUS system consists of the A-BUS adapter plugged into your computer and a cable to connect the Adapter to 1 or 2 A-BUS cards. The same cable will also fit an A-BUS Motherboard for expansion up to 25 cards in any combination.

The A-BUS is backed by Alpha's continuing support (our 11th year, 50000 customers in over 60 countries).

The complete set of A-BUS User's Manuals is available for $10.

About the A-BUS:

- All the A-BUS cards are very easy to use with any language that can read or write to a Port or Memory. In BASIC, use INP and OUT (or PEEK and POKE with Apples and Tandy Color Computers)
- They are all compatible with each other. You can mix and match up to 25 cards to fit your application. Card addresses are easily set with jumpers.
- A-BUS cards are shipped with power supplies (except PD-123) and detailed manuals (including schematics and programming examples).

Relay Card — RE-140: $129

Includes eight industrial relays. (3 amp contacts. SPST) individually controlled and latched. 8 LED's show status. Easy to use (OUT or POKE in BASIC). Card address is jumper selectable.

Reed Relay Card — RE-156: $99

Same features as above, but uses 8 Reed Relays to switch low level signals (20mA max). Use as a channel selector, solid state relay driver, etc.

Analog Input Card — AD-142: $129

Eight analog inputs. 0 to +5V range can be expanded to 100V by adding a resistor. 8 bit resolution (20mV). Conversion time 120us. Perfect to measure voltage, temperature, light levels, pressure, etc. Very easy to use.

12 Bit A/D Converter — AN-146: $139

This analog to digital converter is accurate to .025%. Input range is −4V to +4V. Resolution: 1 millivolt. The on board amplifier boosts signals up to 50 times to read microvolts. Conversion time is 130ms. Ideal for thermocouple, strain gauge, etc. 1 channel. (Expand to 8 channels using the RE-156 card).

Digital Input Card — IN-141: $59

The eight inputs are optically isolated, so it's safe and easy to connect any "on/off" devices, such as switches, thermostats, alarm loops, etc. to your computer. To read the eight inputs, simply use BASIC INP (or PEEK).

24 Line TTL I/O — DG-148: $65

Connect 24 input or output signals (switches or any TTL device) to your computer. The card can be set for: input, latched output, strobed output, strobed input, and/or bidirectional strobed I/O. Uses the 8255A chip.

Clock with Alarm — CL-144: $89

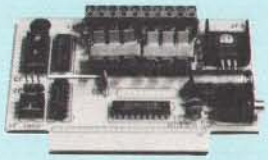
Powerful clock/calendar with: battery backup for Time, Date and Alarm setting (time and date); built in alarm relay, led and buzzer; timing to 1/100 second. Easy to use decimal format. Lithium battery included.

Touch Tone® Decoder — PH-145: $79

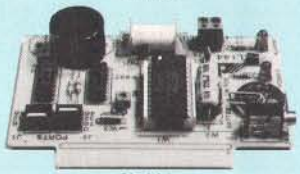
Each tone is converted into a number which is stored on the board. Simply read the number with INP or POKE. Use for remote control projects, etc.

A-BUS Prototyping Card — PR-152: $15

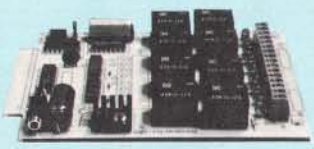
3½ by 4½ in. with power and ground bus. Fits up to 10 I.C.s



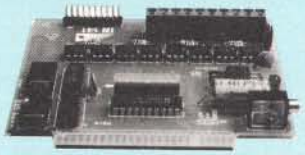
ST-143



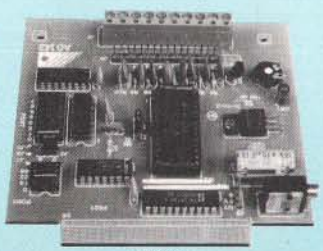
CL-144



RE-140



IN-141



AD-142

Smart Stepper Controller — SC-149: $299

World's finest stepper controller. On board microprocessor controls 4 motors simultaneously. Incredibly, it accepts plain English commands like "Move arm 10.2 inches left". Many complex sequences can be defined as "macros" and stored in the on board memory. For each axis, you can control: coordinate (relative or absolute), ramping, speed, step type (half, full, wave), scale factor, units, holding power, etc. Many inputs: 8 limit & "wait until" switches, panic button, etc. On the fly reporting of position, speed, etc. On board drivers (350mA) for small steppers (MO-103). Send for SC-149 flyer.

Remote Control Keypad Option — RC-121: $49
To control the 4 motors directly, and "teach" sequences of motions.

Power Driver Board Option — PD-123: $89
Boost controller drive to 5 amps per phase. For two motors (eight drivers).

Breakout Board Option — BB-122: $19
For easy connection of 2 motors. 3 ft. cable ends with screw terminal board.

Stepper Motor Driver — ST-143: $79

Stepper motors are the ultimate in motion control. The special package (below) includes everything you need to get familiar with them. Each card drives two stepper motors (12V, bidirectional, 4 phase, 350mA per phase).

Special Package: 2 motors (MO-103) + ST-143: **PA-181: $99**

Stepper Motors — MO-103: $15 or 4 for $39

Pancake type, 2¼" dia, ¼" shaft, 7.5°/step, 4 phase bidirectional, 300 step/sec, 12V, 36 ohm, bipolar, 5 oz-in torque, same as Airpax K82701-P2.

Current Developments

Intelligent Voice Synthesizer, 14 Bit Analog to Digital converter, 4 Channel Digital to Analog converter, Counter Timer, Voice Recognition.

A-BUS Adapters for:

IBM PC, XT, AT and compatibles. Uses one short slot.	AR-133...$69
Tandy 1000, 1000 EX & SX, 1200, 3000. Uses one short slot.	AR-133...$69
Apple II, II+, IIe. Uses any slot.	AR-134...$49
TRS-80 Model 102, 200 Plugs into 40 pin "system bus"	AR-136...$69
Model 100. Uses 40 pin socket. (Socket is duplicated on adapter).	AR-135...$69
TRS-80 Mod 3,4,4D. Fits 50 pin bus. (With hard disk, use Y-cable).	AR-132...$49
TRS-80 Model 4P. Includes extra cable. (50 pin bus is recessed).	AR-137...$62
TRS-80 Model I. Plugs into 40 pin I/O bus on KB or E/I.	AR-131...$39
Color Computers (Tandy). Fits ROM slot. Multipak, or Y-cable.	AR-138...$49

A-BUS Cable (3 ft, 50 cond.) — CA-163: $24

Connects the A-BUS adapter to one A-BUS card or to first Motherboard.

Special cable for two A-BUS cards: CA-162: $34

A-BUS Motherboard — MB-120: $99

Each Motherboard holds five A-BUS cards. A sixth connector allows a second Motherboard to be added to the first (with connecting cable CA-161: $12). Up to five Motherboards can be joined this way to a single A-BUS adapter. Sturdy aluminum frame and card guides included.

Add $3.00 per order for shipping.
Visa, MC, checks, M.O. welcome.
NY residents add sales tax.
C.O.D. add $3.00 extra.
Canada: shipping is $5
Overseas add 10%

ALPHA Products
a division of Sigma Industries, Inc.
242-B West Avenue, Darien, CT 06820

Technical info: **(203) 656-1806**
Orders only (Except in NY) **800 221-0916**
New York orders: **(718) 296-5916**
All lines open weekdays 9 to 5 Eastern time

Inquiry 11

```
PROGRAM NewWrite;

  TYPE
    MaxString = STRING[255];

  PROCEDURE BIOSWriteStr(PosX, PosY : BYTE; s :
                    MaxString; f, b : BYTE);
    (* Write 's' at 'PosX', 'PosY', using foreground
                    color 'f' and background color 'b'.
                    This routine does *not* handle
                    Turbo's windows. The cursor is left
                    where it was on entry. *)
    CONST
     MinX = 1;
     MaxX = 80;
     MinY = 1;
     MaxY = 25;
    VAR
     r     : RECORD
               ax, bx, cx, dx, bp, si, di, ds, es, flags :
                    INTEGER;
             END;
     OldX,
     OldY : BYTE;
     i    : INTEGER;
    BEGIN
     PosX := PosX - 1;
     r.ax := $0f00;
     INTR($10,r);
     r.ax := $0300;
     INTR($10,r);
     OldX := LO(r.dx);
     OldY := HI(r.dx);
     FOR i := 1 TO ORD(s[0]) DO BEGIN
       PosX := PosX + 1;
       IF PosX > MaxX THEN BEGIN
        PosY := PosY + 1;
        PosX := MinX;
       END;
       IF PosY > MaxY THEN BEGIN
        PosY := MaxY;
        (* possibly scroll - beware that IBM PC/XT BIOS
                    scroll routines destroy BP! (Other
                    BIOS' may also.) *)
       END;
       r.ax := $0200;
       r.dx := (PosY-1) * 256 + (PosX-1);
       INTR($10,r);
       r.ax := $0900 + ORD(s[i]);
       r.bx := HI(r.bx) * 256 + 16 * b + f;
       r.cx := $0001;
       INTR($10,r);
     END;
     r.ax := $0200;
     r.dx := OldY * 256 + OldX;
     INTR($10,r);
    END; (* BiosWriteStr *)


  BEGIN

    ClrScr;
    BIOSWriteStr(70,25,'Hello there - this is just a
                    test.',YELLOW,BLACK);
    WRITELN('Testing...');
  END. (* NewWrite *)
```

pascal/turbo #2300, from barryn, Sun Dec 14 12:13:33 1986. A comment to message 2299.

Looks good to me.

pascal/turbo #2301, from bbrown, Sun Dec 14 13:14:27 1986. A comment to message 2299.

Neat stuff! Thank you very much! ■

IMPERIAL JET TURBO PC/XT
(510% FASTER THAN IBM PC/XT)
12 MHZ 1 & 0 WAIT STATE PC/AT
10 MHZ 0 WAIT STATE PC/AT/XT

IMPERIAL JET TURBO PC/XT SYSTEM	$ 679
10 MHZ 0 WAIT PC/AT SYSTEM ★ 110% FASTER THAN IBM AT ★	$1340
12 MHZ MINI PC/AT SYSTEM ★ 135% FASTER THAN IBM PC/AT ★ ★ 6/8/10 MHZ 1 & 0 WAIT SWITCHABLE ★ ★ 12 MHZ 1 WAIT STATE ★	$1440
IMPERIAL JET TURBO PC/XT LCD CONVERTIBLE	$1090
12 MHZ PC/AT TURBO LCD CONVERTIBLE	$1690
IMPERIAL JET TURBO PC/XT MOTHERBOARD	$ 199
10 MHZ 0 WAIT STATE MOTHERBOARD	$ 149
MULTI-DISPLAY CARD ★ MONO/GRA & COLOR/GRA CARD ★	$ 139

IMPERIAL COMPUTER CORP.
935 S. San Gabriel Blvd.,San Gabriel, CA 91776
Tel: (818) 285-1256 (3 Lines)
Telex: 3719072 IMPERIAL FAX : (818) 285-9488

HITACHI · TOSHIBA · NEC · FUJITSU · SIEMENS · SAMSUNG · HYUNDAI · MICRON TECHNOLOGY · TANDON · TEAC · QUME · SEAGATE · WESTERN DIGITAL · MICROSCIENCE · MINISCRIBE · CDC · OKIDATA

American Semiconductor

LEASING NOW AVAILABLE

256K $1.99!

THE BARE XT TURBO SYSTEM
$399 *"Looks, tastes and acts like the IBM, AND, it's 100% COMPATIBLE!"*
FREE SOFTWARE WITH PURCHASE!
(INCLUDES W/P, SPREADSHEET D-BASE MANAGER AND COMMUNICATION. LIMITED TIME OFFER!)
AT CLONES $999.00

NEW 10 MGHZ!



HAYES COMPATIBLE MODEM 300/1200 INT/EXT WITH SOFTWARE $139.00

Portable Clone . . $ 799.
XT Power Supplies (150W) . . . . . 79.
XT/AT Keyboards 69.
External Hard Drive Case with 80W Power Supply . . . . . 169.

100% IBM COMPATIBLE HARD DRIVES
SEAGATE · MICROSCIENCE · MINISCRIBE (5¼" & 3½")

20MB Half Height ST225	299
20MB Portable Shock Mount	325
Hardcards Available	425
30MB Shock Mount Drive	435

HIGH-SPEED HARD DRIVES (RT-AT-XT-RLL Compatible)

20MB AT Hi-Speed	$299
30MB AT Hi-Speed	499
50-160MB	☎

WINCHESTER DRIVE KITS
10MB KIT $199
CALL FOR DETAILS!

CHIPS

41128	$ 3.25
41256K-150	2.39
41256K-200	1.99
4164	.99
8087-3	119.00
8087-2	165.00
80287-3/6	159.00
80287-8	239.00
NEC V-20	14.00

EGA MONITORS AS LOW AS $435

ADD-ON CARDS

Monochrome Graphics V WITH Port Printer	99
Color Graphics Card V	79
Printer Port	29
Multi I/O WITH FLOPPY CONTROLLER	99
Multi Function (6-PAK Lookalike) Card 0 - 384K w Software	99
Hard Drive Controller	99
Hard Floppy Controller AT	190
EGA Cards	239
Floppy Controller w Cables	39

MISCELLANEOUS

Mother Boards (Expandable to 640K) XT Compatible Turbo	$139
TEAC Direct Floppy Drives	99

FLOPPY DISK DRIVES

Mother Boards (Expandable to 640K) XT Compatible Turbo	$139
DSDD 48 TPI 360K Half Height QUME TRAK #142	79
TEAC Direct Drives	99

MONITORS

Composite Monitor	$ 79
Color Monitors AS LOW AS	235
HiRes Monochrome Monitors	89

"OURS does what THEIRS does for a whole lot *LESS!*"...CALL TODAY!

TO ORDER TOLL FREE CALL
1-800-237-5758
EXT. 110

Vendor Line Inside Florida 813-961-9444

TECHNICAL SUPPORT 813-961-5584

PRICES SUBJECT TO CHANGE DUE TO AVAILABILITY AND MARKET FLUCTUATIONS
CALL TODAY FOR ITEMS NOT LISTED AND DEALER PRICING. ADD 3.2% FOR VISA MasterCard

16520 N. Florida Ave., Lutz, Florida 33549

HITACHI · TOSHIBA · NEC · FUJITSU · SIEMENS · SAMSUNG · HYUNDAI · MICRON TECHNOLOGY · TANDON · TEAC · QUME · SEAGATE · WESTERN DIGITAL · MICROSCIENCE · MINISCRIBE · CDC · OKIDATA

BYTE Subscriber Services Available

Your BYTE subscription brings you a complete diet of the latest in microcomputer technology every 30 days. The kind of broad-based objective coverage you've read in this issue. To ensure that you receive the best possible service during the term of your subscription, we have listed below a wealth of services available to you as a BYTE subscriber.

DISCOUNTS

☑ Group discounts available for one-year subscriptions. For details write to the following address:

BYTE Group Subscriptions
P.O. Box 6821
Piscataway, NJ 08854 USA

SERVICES

☑ ***BIX:*** BYTE's Information Exchange puts you on-line 24 hours a day with your peers via computer conferencing and electronic mail. All you need is a microcomputer, a modem and a password. See the BIX ad (refer to Index for page) in this issue of BYTE for cost information on foreign registration and usage.

☑ ***Reader Service:*** For information on products advertised in BYTE, circle the numbers on the Reader Service Card enclosed in each issue that correspond to the numbers for the advertisers you select. Drop in the mail and we'll get your inquiries to the advertisers.

☑ ***Program Listings:*** Listings of programs that accompany BYTE articles are now available on BIX, on disks or in quarterly printed supplements (see reply cards in this issue).



☑ ***Microform:*** BYTE is available in microform from University Microfilm International in the U.S. and Europe.

☑ ***BYTE's BOMB:*** BYTE's Ongoing Monitor Box is your direct line to the editor's desk. Each month, you can rate the articles via the Reader Service Card. Your feedback helps us keep up to date on your information needs.

☑ ***Subscription Service:*** If you have a problem with, or a question about your subscription, you may contact us at the following addresses.

Europe:
BYTE Subscriptions
McGraw-Hill House
Maidenhead, Berkshire
England SL6 2QL

Outside Europe:
BYTE Customer Service
P.O. Box 6821
Piscataway, NJ 08854 U.S.A.

Mail us the details along with the name, address and postal codes of the subscription. If the problem involves a payment, please include a copy of the credit card statement or front and back of your cancelled check. For information regarding back issues and editorial indicies, write to the following address:

BYTE Customer Service Department
Box 328
Hancock, NH 03449 U.S.A.

BONUSES

☑ ***Annual Separate Issues:*** In addition to BYTE's 12 monthly issues, subscribers also receive our annual IBM PC issue free of charge, as well as any other annual issues BYTE may produce.

Be on the leading edge of micro technology. Subscribe to BYTE magazine and in addition benefit from all the aforementioned services. Complete and mail in a subscription card from the adjacent page.

And . . . welcome to BYTE country!

BYTE
THE SMALL SYSTEMS JOURNAL

McGraw-Hill

Order your BYTE subscription with one of the convenient order cards in this issue or through a McGraw-Hill representative or magazine agency listed below:

McGraw-Hill Representatives:

France:
McGraw-Hill
18 Rue Des Cordonniers
78600 Maisons Lafitte
1-39-62-57-79

Italy:
McGraw-Hill/Ceti
Lungo Po Antonelli 205
10153 Torino
11-8999023

Netherlands:
McGraw-Hill Benelux
Waaldijk 8
5327 AC Hurwenen
Netherlands
04182-1553

Scandinavia:
McGraw-Hill
Holm Marketing
Granstuevej 13
DK-2840 Holte
Denmark
2-422-806

Spain:
McGraw-Hill De Espana
Santa Beatriz 4
28038 Madrid
1-433-8777

Turkey:
McGraw-Hill
Halitaga Kad Eksioglu Ishani
Kad 4 No 101 Kadikoy
Istanbul
11-337-8145

United Kingdom:
Circulation Field Sales
McGraw-Hill
McGraw-Hill House
Maidenhead, Berkshire SL6 2QL
England
0628-23431

Austria/Switzerland/West Germany:
McGraw-Hill
Postfach 40 02 69
D-8000 Munchen 40
West Germany
89-525847

Agencies:

Austria:
Minerva
Postfach 367
A-1001 Vienna

Belgium:
Office International Periodiques
Avenue Louise 485
B-1050 Brussels

Denmark:
Harck & Gjellerup Booksellers
G.E.C. Gad Norreport
31-33 Fiolstraede
DK-1171 Copenhagen K

United Kingdom:
Blackwells Periodicals
PO Box 40
Hythe Bridge Street
Oxford OX1 2EU

Finland:
Akateeminen Kirjakauppa
PO Box 128
SF-00101 Helsinki 10

France:
Dawson France
Rue De La Prairie
91121 Palaiseau Cedex

Greece:
A. Atzemiam & Co
9 Amerikis Street
Athens 10672

Italy:
D.E.A.
28 Via Lima
00198 Rome

Netherlands:
Faxon Europe
2 Voorburgwal 60
Box 197
1012 SC Amsterdam

Norway:
Narvesen As Subscriptions
Boks 6125
Etterstad, Oslo 6

Portugal:
Fernando Machado & Co
15 Rua Das Carmelitas
4000 Porto

Spain:
Diaz De Santos Sa
Liberia Cientificio Tecnica
Calle De Lagasca 95/PO Box 6.050
Madrid 6

Sweden:
Esselte Tidskriftscentralen
PO Box 45150
5-10430 Stockholm

Switzerland:
Hans Huber
Langgasstrasse 76 & Marktgasse 9
3000 Bern 9

Turkey:
Caglayan Kitabevi
Beyoglu Takaoliyan Ust Pasaj
7-8-9-21 Istanbul

West Germany:
Kunst & Wissen
Willhelmstrasse 4
Postfach 46
D-7000 Stuttgart 1

Yugoslavia:
Cankarjeva Zalozba
Postni Predai 201
61001 Ljubljana

Remember how computers remembered? Mercury delay lines? Punched cards with 90 columns and round holes? Hand-wired magnetic cores? In case your memory needs refreshing, The Computer Museum would like to share its memories with you.

The Computer Museum Memory Poster
We have created a limited edition, 20"x32" poster of the picture shown below. Printed in full-color, it includes an identification key to help you recall the memories you've forgotten. To get your poster, along with an information kit on museum membership, exhibits and activities, send a tax-deductible contribution of $25 or more to:
Memory Poster, The Computer Museum,
300 Congress Street, Museum Wharf,
Boston, MA 02210.
Please allow six weeks for delivery.

YES! Please refresh my computer memories. A tax-deductible donation of $25 or more made payable to The Computer Museum is enclosed.

Name_____

Address_____

City_____ State____ Zip_____

The Computer Museum
Located on Museum Wharf
300 Congress Street, Boston, MA 02210
(617) 426-2800

A

COMPUTER MEMORIES FOR SALE

Special thanks to this publication, Scitex America Corp. (color separations), Grafik Communications, Ltd. (design), David Sharpe Studio (photography) and VM Software, Inc. (poster).



Six great reasons to join BIX today

- **Over 140 *microcomputer-related conferences*:**
Join only those subjects that interest you and change selections at any time. Take part when it's convenient for you. Share information, opinions and ideas in focused discussions with other BIX users who share your interests. Easy commands and conference digests help you quickly locate important information.

- ***Monthly conference specials*:**
BIX specials connect you with invited experts in leading-edge topics—CD-ROM, MIDI, OS-9 and more. They're all part of your BIX membership.

- ***Microbytes daily*:**
Get up-to-the-minute industry news and new product information by joining Microbytes.

- ***Public domain software*:**
Yours for the downloading, including programs from BYTE articles and a growing library of PD listings.

- ***Electronic mail*:**
Exchange private messages with BYTE editors and authors and other BIX users.

- ***Vendor support*:**
A growing number of microcomputer manufacturers use BIX to answer your questions about their products and how to use them for peak performance.

What BIX Costs. . How You Pay

ONE-TIME REGISTRATION FEE: $25

Hourly Charges: (Your Time of Access)	**Off-Peak 6PM–7AM** Weekdays Plus Weekends & Holidays	**Peak 7AM–6PM** Weekdays
BIX	$9	$12
Tymnet*	$2	$6
TOTAL	**$11/hr.**	**$18/hr.****

* *Continental U.S. BIX is accessible via Tymnet from throughout the U.S. at charges much less than regular long distance. Call the BIX helpline number listed below for the Tymnet number near you or Tymnet at* 1-800-336-0149
** *User is billed for time on system (i.e., ½ Hr. Off-Peak w/Tymnet = $5.50 charge.)*

BIX and Tymnet charges billed by Visa or Mastercard only.

BIX HELPLINE
(8:30 AM–11:30 PM Eastern Weekdays)
U.S. (except NH)—1-800-227-BYTE
Elsewhere (603) 924-7681



We'll Send You a BIX *User's Manual and Subscriber Agreement as Soon as We've Processed Your Registration.*
JOIN THE EXCITING WORLD OF BIX TODAY!

JOIN BIX RIGHT NOW:
Set your computer's telecommunications program for full duplex, 8-bit characters, no parity, 1 stop bit OR 7-bit characters, even parity, 1 stop using 300 or 1200 baud.
Call your local Tymnet* number and respond as follows:

Tymnet Prompt	**You Enter**
Garble or "terminal identifier"	a
login:	bix <CR>
BIX Logo—Name:	new <CR>

After you register on-line, you're immediately taken to the BIX learn conference and can start using the system right away.

FOREIGN ACCESS:
To access BIX from foreign countries, you must have an account with your local Postal Telephone & Telegraph (PTT) company. From your PTT enter 310600157878. Then enter bix <CR> and new <CR> at the prompts. Call or write us for PTT contact information.

BIX
ONE PHOENIX MILL LANE
PETERBOROUGH, NH 03458
(603) 924-9281

THE BUYER'S MART
A Directory of Products and Services

THE BUYER'S MART is a monthly advertising section which enables readers to easily locate suppliers by product category. As a unique feature, each BUYER'S MART ad includes a Reader Service number to assist interested readers in requesting information from participating advertisers.

RATES: 1x—$475 3x—$450 6x—$425 12x—$375
Prepayment must accompany each insertion. VISA/MC Accepted.

AD FORMAT: Each ad will be designed and typeset by BYTE. Advertisers must furnish typewritten copy. Ads can include headline (23 characters maximum), descriptive text (250 characters maximum), plus company name, address and telephone number. Do not send logos or camera-ready artwork.

DEADLINE: Ad copy is due 2 months prior to issue date. For example: October issue closes on August 1. Send your copy and payment to THE BUYER'S MART, BYTE magazine, 70 Main Street, Peterborough, NH 03458. For more information call Karen Burgess at BYTE 603-924-3754.

ACCESSORIES

COMPUTER PROTECTION
• UPS • LINE CONDITIONERS • ISOLATORS
• MODEM PROTECTORS
• AC POWER INTERRUPTERS
— HUNDREDS OF HINTS & PRODUCTS —
FREE CATALOG **1-800-225-4876**
ELECTRONIC SPECIALISTS, INC.
171 So. Main St., POB 389, Natick, Mass 01760
1-800-225-4876

Inquiry 681.

FREE CATALOG
Thousands of parts and new surplus electronic parts at super low prices. FAST ORDER PROCESSING AND SHIPPING (95% of all orders shipped within 48 hours).
CALL OR WRITE FOR A FREE CATALOG. . .
ALL ELECTRONICS CORPORATION
POB 20406, Los Angeles, CA 90006-0406
1-800-826-5432

Inquiry 650.

• RIBBONS •
— OVER 300 AVAILABLE —

	BLACK	COLORS
APPLE IMAGEWRITER	$2.25	$2.75
DIABLO HT 2 m/s	2.40	n/a
EPSON MX-RX 70/80	2.25	2.75
OKIDATA 80-82-92	.85	1.25

Nationwide **1-800-331-6841**
In Ohio **1-513-865-0947**
MC/VISA/AMEX DEALER SUPPLIES

Inquiry 676.

. . .SOFTWARE PUBLISHING. . .
GDS offers a wide variety of services that will help get your software to the market. Address your needs with GDS.
• IBM style cloth/vinyl 3-ring binders/slips.
• Labels, sleeves, disk pages, bulk diskettes. . .
• Disk duplication with 100% verification.
• Shrink wrapping and product assembly.
• Quick turn-around.
A well packaged product can make the difference in making a sale. Call us now! VISA/MC.
GLENCO DEVELOPMENT SYSTEMS(312) 392-2492
3920 Ridge Ave., Arlington Hts., IL 60004

Inquiry 692.

LOWEST PRICES ON DISKETTES
5¼" DSDD 39¢, High Density $1.25.
3½" SSHD $1.35, DSHD $1.45.
• Lifetime warranty • Includes tyvek sleeves
• 100% error free • Reinforced hub ring
• Finest quality • Labels & write protect tabs
• Boxed Products • Same day shipping
Add 3.00 shipping per 100. Minimum 100 diskettes.
Send check or call. CA residents add 6½% sales tax.
Data Bureau Inc. **213-479-0345**
1633 Westwood Blvd., Ste. 120, Los Angeles, CA 90024

Inquiry 673.

ACCESSORIES

Self-Inking Printer Ribbon
For users of **Okidata** and other open spool ribbon printers. Controlled Printout Devices are a new kind of printing ribbon that re-ink themselves, and will last 15 times longer than the ribbon you are now using. For further information please call or write.
CONTROLLED PRINTOUT DEVICES, INC.
POB 869, Baldwin Rd., Arden, NC 28704
(704) 684-9044

Inquiry 670.

IBM PC ACCESSORIES!
Our NEW Catalog includes every Accessory ANY IBM PC USER might want! PC Stands/Pedestals, Travel Cases/Dust Covers, Switches/Cables, Buffers/Converters, Surge Protectors, Floppys/Ribbons, PC Toolkits and MORE! Low Direct Prices, Same Day Shipping and Satisfaction Guaranteed! Simply call/write for a FREE COPY of our LATEST CATALOG today.
Tipz Direct, Inc. Simply Call **1-800-FOR-TIPZ**
P.O. Box 690, San Francisco, CA 94101-0690
1-800-367-8479 or 415-567-4067

Inquiry 759.

CARTRIDGES & MORE!
Nylon or multistrike cartridges in limited quantities for COLECO ADAM. $19.50/dz. & $2.50 ship. in CA 6% sales tax. Free 62 page catalog with 1,000's of cartridges & other accessories for all computers.
Allied Business Machines, Dept. B
9281 Earl, La Mesa, CA 92042

Inquiry 651.

BAR CODE

BAR CODE READERS
Read Bar codes into any program with program-transparent, keyboard interface Bar Code Reader for IBM PC, AT and compatibles-**$385.** Minis/CRTs/micros RS-232 Reader-**$399.** All metal construction, auto-discrimination of 9 bar codes. Portable Readers for physical inventories-**$650.**
Worthington Data Solutions
130 Crespi Court, Santa Cruz, CA 95060
(408) 458-9938

Inquiry 767.

BAR CODE MADE EASY
PERCON® E-Z-READER™ keyboard interfaces and multi-user RS-232 models make it easy to add bar code to virtually any computer/terminal WITHOUT SOFTWARE MODIFICATION. Immediate shipping. two year warranty. Bar code printing software available. Call for details on fast, accurate, easy data entry. Substantial reseller discounts.
PERCON®
2190 W. 11th St., Eugene, OR 97402
(503) 344-1189

Inquiry 722.

BAR CODE

DATA INPUT DEVICES
Bar Code & Magnetic Stripe Readers for microcomputers & terminals, including IBM, DEC, AT&T, CT, Wyse, Wang. All readers connect on the keyboard cable & are transparent to all software. Low cost bar code print programs & magnetic encoders are also available.
TPS Electronics
4047 Transport, Palo Alto, CA 94303
415-856-6833 Telex 371-9097 TPS PLA

Inquiry 761.

PRINT LABELS READABLE AT 50 FT.
Print Labels with Large Text and/or bar codes on PC with Epson/Okidata/IBM printers. Text to 1"x1" reads at 50 ft. Bar codes 39, I 2of5, UPC/EAN, MSI, DOD-LOGMARS, AIAG. Menu driven **$49-299.** OR print from any program (i.e., dBase, Lotus, Wordstar) **$179; $239** large text. Subrtns too for BASIC, Turbo, C.
Worthington Data Solutions
130 Crespi Court, Santa Cruz, CA 95060
(408) 458-9938

Inquiry 767.

BUSINESS OPPORTUNITIES

THE GUIDE TO HIGH-TECH CONSULTING AND CONTRACTING
New step-by-step, how-to information book: Getting started, career building, hardware & software job sources: part/fulltime, career change, moonlight. Contracts; taxes; client/job shop/recruiter negotiationg techniques. Business/finance, engineering, scientific. Author strategies raises wages! $16.95 + $3 postage.
Madden Associates
Dept. B, 2039-F Civic Center Drive
North Las Vegas, NV 89030

Inquiry 706.

COMMUNICATION

ASYNC MANAGER & TUTORIAL
Interrupt driven transmit & receive ★ Buffered I/O to 64K ★ XON/XOFF ★ Modem controls ☆ XMODEM ☆ Use four comm ports simultaneously ★ Written in assembler ★ HLL calls for C and Pascal ★ Complete with object libraries, sample programs, and a comprehensive manual. Currently supports Lattice C, MS-C, and MS Pascal. Please specify language and compiler when ordering.
$59 + $4 S&H. (CA 6%) Cash/CK/MO only
CIRRUS SOFTWARE
P.O. Box 51924, Palo Alto, CA 94303
(415) 949-4254

Inquiry 666.

COMPUTER DIGITIZERS

VIDEO IMAGE PROCESSING
• STORE VIDEO PICTURES ON DISK
• CAPTURE & PRINT REAL-WORLD IMAGES
• Custom Applications Include:
  – Video Databases
  – Desktop Publishing
  – PC Based Video Telephones
  – Color/B&W T-Shirt Systems
• Digitizers (Computer Eye, Chorus, etc.)
• Video Toolkits for DBASE III, LOTUS 123, etc.
See HAL SYSTEMS next page.

Inquiry 694.

THE BUYER'S MART

COMPUTER DIGITIZERS

HAL SYSTEMS
Image Processing Specialists
674 Route 202–206N
Bridgewater, NJ 08807
1-800-227-0158
(in NJ 201-218-1818)
201-469-0049 (24 hr. BBS/Modem)
"A picture is worth a thousand words"

Inquiry 694.

COMPUTER INSURANCE

COMPUTER OWNERS INSURANCE
Call toll free for coverages and premiums
• COMPUTERS OVERSEAS
• COMPUTERS YOU LEASE
• COMPUTERS YOU LEASE TO OTHERS
SAFEWARE
The Insurance Agency Inc.
1-800-848-3469
IN OHIO (614) 262-0559

Inquiry 738.

CROSS ASSEMBLERS

ASSEMBLERS & TRANSLATORS
Over 20 high quality, full function, fast relocatable and absolute macro assemblers are available immediately. Source language translators help you change microcomputers. Call for info about MS/DOS, CPM80, ISIS versions.
RELMS™
P.O. Box 6719
San Jose, California 95150
(408) 265-5411
TWX 910-379-0014

Inquiry 734.

DATA/DISK CONVERSIONS

CONVERSION SERVICES
Convert any 9 track magnetic tape to or from over 700 formats including 3½", 5¼", 8" disk formats & word processors. Disk to disk conversions also available. Call for more info. Introducing OCR Scanning Services.
Pivar Computing Services, Inc.
165 Arlington Hgts. Rd., Dept. #B
Buffalo Grove, IL 60089 **(312) 459-6010**

Inquiry 725.

Disk/Disk • Tape/Disk
Over 600 formats! 3½, 5¼, or 8 inch disks; 9 track mag tape; 10 MB Bernoulli cartridge. Data base and word processor translation specialists.
Computer Conversions, Inc.
9580 Black Mountain Rd., Ste J
San Diego, CA 92126
(619) 693-1697

Inquiry 668.

DISK/DISK or TAPE/DISK CONVERSIONS — AUTOMATICALLY
Bought a new computer? Convert your data in just 1-2 days.
SAVE TIME - SAVE MONEY!
DISK/DISK or TAPE/DISK Conversions start as low as **$14.00** for IBM, CP/M, MS-DOS, UNIXV, XENIX & most other systems. (Apple, MacIntosh, Commodore conversions start at $25.00). Call or write today for a cost saving quotation to fill your disk-to-disk or tape-to-disk data conversion needs.
CREATIVE DATA SERVICES
1210 W. Latimer Ave., Campbell, CA 95008
(408) 866-6080

Inquiry 671.

DATA/DISK CONVERSION

INTERCHANGE HEWLETT PACKARD FILES ON IBM PC
IBM PC to HP File Copy allows IBM PC's and compatibles to read and write files written by Hewlett Packard Series 70, 80, 200, 300, 1000, 9000 computers. Call for data sheets, config diagram, pricing. Oswego Software Inc. specializes in HP disk file copying, program translators.
Oswego Software Inc.
507 North Adams Street, Oswego, Illinois 60543 USA
(312) 554-3567 **TELEX 858757**

Inquiry 717.

DOCUMENTATION

COMPUTER ASSEMBLY MANUALS
BIG BLUE SEED for IBM™ BUILDERS: Parts list, placement diagrams, instructions for assembling **75** bare cards. Now includes 640K, Turbo & AT MthBds. **$17.95.** *APPLE™ BUILDERS NEED APPLE SEED:* Instructions for assembling **85** Apple-compatible bare cards including the popular 6502 II+ and IIe MthBds. **$14.95**
Both for $30. Bare cards available. Check/MO/VISA/MC.
NuScope Associates*, Dept B
P.O. Box 790 • Lewiston New York • 14092
*A Division of Kosmic MicroTech Inc.

Inquiry 715.

DUPLICATION SERVICES

FULL SERVICE DUPLICATION
Speed, Quality, Value, Security, Support,
•
SATISFACTION GUARANTEED
800-222-0490
(201) 462-7628 (in NJ)
MegaSoft, Inc.
P.O. Box 710, Freehold, NJ 07728

BLANKET SERVICES
Diskette duplication • Packaging • Stocking/Drop shipping • 48 hour delivery • SUPERLoK copy protection • No mastering fee • No charge for standard labels •
Star-Byte, Inc.
713 W. Main St., Lansdale, PA 19446
215-368-1200 **800-243-1515**

Inquiry 749.

EDUCATION

COMPUTER FACT BOOK
• LEARN about Computers the Easy way.
• Written in Clear, Easy to understand English.
• Facts, Short Cuts, a Wealth of information, Hundreds of ways to Improve your skills.
• When You Need reliable Information Fast turn to the COMPUTER FACT BOOK
for FREE Information write to:
COMPUTER & ARTS Publications
5580 La Jolla Blvd., Suite 472-G
La Jolla, CA 92037

Inquiry 667.

FLOW CHART

FLOW CHARTING II+ HELPS YOU!
Precise flowcharting is fast and simple with **Flow Charting II+.** Draw, edit and print perfect charts: bold and normal fonts, 24 shapes — 95 sizes; fast entry of arrows, bypasses & connectors; Fast Insert Line; shrink screen displays 200-column chart; 40 column edit screen for detail work, much more!
PATTON & PATTON
81 Great Oaks Blvd., San Jose, CA 95119
1-800/672-3470, ext. 897 (CA residents)
1-800/538-8157, ext. 897 (Outside CA)
408/629-5044 (Outside the U.S.A.)

Inquiry 719.

HARDWARE

SANYO 550/555 USERS

TURBO BOARD-7.2 MHZ	$ 95.00
20 MEG EXTERNAL HARD DISK SYSTEM	$749.95
SANYO VIDEO BOARD (ORIGINAL)	$174.95
RS-232 BD.	$ 49.95
HARD DISK CONT W/CABLES & SOFT (ST-506)	$249.95
768K MEM, CLK, & EXPANSION BD- (FREE RAMDISK, SPOOLER, & SOFTVIDEO-RUNS IBM PROGRAMS)	$199.95

TAMPA BAY DIGITAL
1807 Gulf-to-Bay Blvd., Clearwater, FL 33575
813-443-7049

Inquiry 756.

EPROM/EEPROM PROG. $250
Programs 2716-27512, 25xx and 68764/66 eproms via RS-232. Also 874x micros and 28xxA & 52Bxx EEPROMs. Automatic baud rate select, built in help menus, no personality modules!
16 BIT I/O MODULE $75
Low cost control via RS-232. Expands to 512!
INTELLITRONICS
P.O. Box 3263, Tustin, CA 92680
(714) 669-0614

Inquiry 697.

USED APPLES & IBM's
Macintosh 512K — **$1150.00**
Apple II+ and IIe — **call**
Imagewriter I — **$275.00**
Motherboards & accessories — **call**
We buy, sell, & horsetrade — Apple, IBM, & CBM.
SHREVE SYSTEMS
845 Lark Ave., Shreveport, LA 71105
318-865-6743 4-9 p.m. C.S.T. VISA/MC

Inquiry 742.

$AVE Direct Manufacturer XT/AT Compatible Wholesaler

XT Clone Bare Bone (case, 150WPS,640K)	$295
XT Complete System (above + (2) Fujitsu Drives Hi-res Monitor, Mono Graphic Card, Keyboard, 2pp, 1sp, RTC)	$695
AT Clone Bare Bone (case, 200WPS, 512K, Phoenix Bios, 80286 6/10 Mhz)	$695
AT Complete System (above + 1.2MB, F/D Controller, Hi-res Monitor, Mono Graphic Card, Keyboard, 2pp, 1sp, RTC)	$1195

Dealer Inquiries Invited Complete Computer Accessories/Peripherals
DAR HAN CORP. Visa/MC/AE Accepted
908 E. Main St., Alhambra, CA 91801
(818) 570-0396 or 284-2142
G/Net Advanced Netware Available

Inquiry 672.

MEGABYTES OF MEMORY
Lowest Prices Guaranteed in US. Dealer Inq. Invited
Fully Populated 2MB Memory Boards
TALLTREE SYSTEMS — JRAM BOARDS

JRAM 2	$134	OPEN 7
JRAM 3 Aboveboard	183	DAYS A WEEK
JRAM AT	183	M-F 9-8
JRAM AT Aboveboard	239	S-S 9-6
JDISKETTE	135	VISA, MC, AE, CHOICE
JLASER I	275	**703-847-4740**
JMODULES	CALL	**800-642-2395**

Information and Technology Services, Inc.

Inquiry 696.

XPNDR2 PROJECT CARDS
FOR THE COLOR COMPUTER DISK SYSTEM
The 6809E signals are brought out to pins on a 40-pin wirewrap connector; on top the disk controller mounts vertically. 4.3X7.2" drilled for ICs; 5V and GND buses; all the right stuff. Includes App Notes. Cardguide available. Free Brochure.
ROBOTIC MICROSYSTEMS
BOX 30807, SEATTLE, WA 98103
(206) 782-6809

Inquiry 736.

THE BUYER'S MART

HARDWARE

P68000 μLAB™ — Notebook Computer™

The Power of a 68000 in a binder for hardware interfacing & machine language programming. A SELF CONTAINED LABORATORY

P68000 LAB™ includes: a 68000μP, 4K SRAM, Cassette Interface, LED Display, 8K EPROM, Integral Keypad, P68000μLAB™ operating system

Optional Accessories Include: Analog-Digital Converter, Digital Signal Processors, 3 Wire Wrap Expansion Kits

EDUCATIONAL & STUDENT PRICE - $197.50

To Order, Call ***QUASITRONICS*** at **1-800-245-4192**
In PA 1-412-745-2663

Also Available for 8086 — **P8086 μLAB™**

Inquiry 731.

HARDWARE/ADD-ONS

Motherboard Clock $59

SideClock does not use an expansion slot! The Innoventions' Clock/Calendar, installs in seconds: Just open the computer cover and snap it into place. Never enter the time and date again, SideClock does it for you. Replacable battery & software included. 30 day $$ back gtd. 2 year limited warranty. $59 + $3 s/h. Site discounts. Dealers welcome.

ARISTO
16811 El Camino #213-D, Houston, TX 77058
713/480-6288 **800/3ARISTO**

Inquiry 656.

PC I/O BOARDS

- Four Port RS-232 w/software **$349.00**
- RS-422/485 Serial **$149.00**
- RS-232/422 with 24 Parallel I/O **$199.00**
- RS-422 Synchronous **$299.00**
- EPROM/RAM **$199.00**
- A/D & Digital I/O **$299.00**

Call About Custom Designed Boards

Sealevel Systems Inc.
P.O. Box 1808, Easley, SC 29641
(803) 855-1581

Inquiry 740

640K Motherboard UPGRADE

640K memory *without using an expansion slot!* Allows easy insertion of 256K chips on the system board. 100% compatible. 30 day $$ back guarantee. Compaq Portable & plus: $29; $94 with memory. IBM-XT, 3270 & Portable: $39, $104 with memory. IBM-PC: $49; $114 with memory. $4 s/h. Site discount. Dealers welcome.

ARISTO
16811 El Camino #213-D, Houston, TX 77058
713/480-6288 **800/3ARISTO**

Inquiry 657.

APPLE COMPATIBLE PRODUCTS

IIe RAM/80 Column Boards, 64K **$39.** 256K **$109.** 512K **$139.** 1.OMEG **$238.** 256K-1.OMEG includes XMe PLUSWORKS Sfwr. II+ 80 Col Bd **$49.** IIe Keypad w/16 Keys **$39.** II+/e Cooling Fan w/surge protect **$29.95.** Add **$3** Shipping. Write for complete list.

NEXO DISTRIBUTION
914 East 8th St., Ste. 109, National City, CA 92050
(619) 474-3328

Inquiry 713.

Z80™ / HD64180/CP/M™ CO-PROCESSORS
Plug-in co-processors for PC, PC/AT.
Blue Thunder Z80 co-processors
6-mhz **$249.95** 10-mhz **$399.95**
12.5-mhz **$599.95**
HD64180 co-processors **$295** and up
All co-processors with CP/M emulator. Software only emulator **ZSIM** only $99.95.
Z-WORLD **408-980-1678**
2065 Martin Ave. #110, Santa Clara, CA 95050
See Ad Page 198.

Inquiry 340

HARDWARE/ADD-ONS

DOUBLE!

Double your hard disk storage capacity with a PERSTOR 200 Series Controller. Advanced RLL encoding is used to increase data transfer rate to 9 or 10 mbits/sec. The PERSTOR 200 Series Controller works with most ST506/412 drives. Call for more info.

Systems and Software, Inc.
7825 East Redfield Road, Scottsdale, Arizona 85260
(602) 948-7313

Inquiry 755.

HARDWARE COPROCESSOR

HARDWARE/COPROCESSOR
PC COPROCESSOR/MEMORY CARD
Turn Your PC into a Mini!

The PC 4000 plug-in card for PC and compatibles uses the high speed Novix Forth CPU that executes Forth in silicon—no assembler. At 4 MIPS, 100+ times faster than the PC. PC4000 and PC run in parallel and share up to 512K on-card memory. Forth software included. C also available.

Software Composers
210 California Avenue, Suite I, Palo Alto, CA 94306
(415) 322-8763

Inquiry 746.

HARDWARE/GRAPHICS

HOUSTON INSTRUMENTS PLOTTERS

Houston DMP-40/41&42: A-B/C-D-size	**$966/$2577**
Ioline LP3700 A-E size, 1 pen	**$3364**
DIGITIZERS	
Summagraphics MM1201, pow, cable	**$374**
GTCO MD7-1212 complete	**$516**
Hitachi HDG-1111B Tiger II w/stylus	**$735**
GRAPHICS BOARD/MONITOR COMBOS	
Orchid TurboEGA & NEC Multisync	**$1099**
Artist 1 & Mitsubishi 19" monitor (C6922LPAG)	**$3418**

Large corp. & institutional PO's accepted O.A.C.

ARDEN SYSTEMS, INC. (213) 479-6707 ext. 29
12335 Santa Monica Bl. #240, Los Angeles, CA 90025

Inquiry 655.

HARDWARE/PERIPHERALS

MORE THAN A MIDI INTERFACE

• Use MIDI software for scoring, sequencing, interactive music training, etc. ***with your own musical instrument*** or MIDI input • Drive MIDI synthesizers, effects, recorders, drum machines etc. from any acoustic instrument. Avail. for Commodore 64, Apple II, Mac, Atari, Amiga, & more. $189.00 U.S. (plus $10.00 S&H) • Money Back Guarantee Payment by money order, VISA or Mastercard.

PITCHRIDER ™ by IVL
IVL Technologies Ltd.
3318 Oak St., Victoria, B.C. Canada, V8X 1R2
(604) 383-4320

Inquiry 699.

LOAD CELL INPUT & CONTROL
Local/remote control of plant processes via multi-drop bus from single serial port; compatible with all computers. Basic software included.

- Load cell input • 8 channel AC output •
- 24 channels AC/DC input/output •
- Count up/down/metered pump control •

SCALE-TRON INC.
P.O. Box 424, Lachine, Quebec, H8S 4C2 Canada
(514) 634-7083

Inquiry 739.

Tape Backup for TANDY 6000 XENIX

The X-Drive provides 25 MB of data storage on a 3M DC600A ¼" tape cartridge. No card slot is used. Call or write for complete information.

RADIO RANCH, INC.
11658 W. Judson Road, Polo IL 61064
815/946-2371 **Telex 910-240-0220**

Inquiry 733.

HARDWARE/PERIPHERALS

GM CAR COMPUTER READ-OUT

Diagnostic Data from 1980 ½ & newer cars are presented on C64 or IBM PC for study. NEW: *Interface for '87 cars with high data rates for IBM PC analysis.* Trouble shoot or study car performance. Interfaces with Basic programs from $120 to $200. Write for product information

EXECUTIVE ELECTRONICS, INC.
938 Main St. Dept. B., Yarmouthport MA 02675
(617) 362-3694

Inquiry 684.

HDWRE/POWER PROTECT.

POWERLINE GREMLINS??
POWER FAILURES??
The MEIRICK STANDBY POWER SYSTEM is the TOTAL SOLUTION to your powerline problems.
400 watt system - **$495;**
800 watt system - **$795**

MEIRICK Inc., POWER SYSTEMS DIV.
Box 298, Frisco, CO 80443 **303-668-3251**

LAPTOP COMPUTERS

IBM & MACINTOSH
$799 SIX LB. LAPTOP COMPUTER

Choose the new Tandy 102 or NEC 8201 portable computers & combine it with our battery-operated 3/2" disk drive, integrated ROM software (the Ultimate ROM II), carrying bag, & either our IBM "LAPDOS" or Macintosh "MACDOS" disk sharing software. Just plug our portable disk directly into your IBM or Macintosh serial port for complete data compatibility with your favorite software. For FREE laptop catalog 1-800-343-8080.

Traveling Software, Inc.
19310 North Creek Parkway, Bothell, WA 98011
(206) 483-8088

Inquiry 762.

MAILING LIST

Professional List Management

ArcList — mainframe mailing list management for the PC/XT/AT. Capacity 20 million names, automatic zip and state verification, print any label, custom charts and reports, merge-purge with excellent near-dupe recognition, match codes, postal presorting, Nth sampling, much more. **$595.** Demo disk available. Take control of your list. Call for free brochure.

Arc Tangent, Inc.
923 Olive St., POB 2009, Santa Barbara, CA 93120
800-843-5928 (in CA. **805-965-7277**)

Inquiry 654.

MODEMS

MODEMS — AS LOW AS **$119**

300/1200 Baud, external. 2 year warranty — free compuserve time. Toll-free customer service number. Hayes Compatible AT Command set, Auto Answer/Autodial RS232C Connector — 8 led status lights. We will beat any advertised price. Compatible with most computers and terminals.

We accept Visa/MC

JEMCO SYSTEMS
POB 511263, Salt Lake City, UT 84151-1263
800-433-4606 (in Utah) 298-1661

Inquiry 700.

PUBLIC DOMAIN

IBM, CP/M, MAC SOFTWARE

Over 2500 disks covering IBM/ PCDOS/ MSDOS, CP/M and MacIntosh. All major public domain user groups represented. Priced from **$6** (US) disk (even lower in quantity). Fast service, shipped around the world. Call or circle inquiry #664 for our FREE 32 page minicatalog of highlights.

CANADA REMOTE SYSTEMS LIMITED
(1-800-387-1901) **(1-416-231-2383)**

Inquiry 664.

THE BUYER'S MART

PUBLIC DOMAIN

→ PUBLIC DOMAIN SOFTWARE ←
50 AMIGA DISKETTES — **$8.50** each. 25 ATARI-ST DISKETTES — **$8.50** each. 490 IBM DISKETTES — **$4.25** each. 60 SANYO 550/555 DISKETTES — **$4.25** each. SAMPLE DISKETTE & CATALOG: AMIGA or ATARI-ST **$8** ppd. IBM or SANYO **$5** ppd
All prices include FREE SHIPPING! Visa/MC - No Extra Charge! 48 hr. Turnaround! Phone Orders Welcome! Quality Media Used!

Computer Solutions
P.O. Box 354 - Dept. B, Mason, Michigan 48854
1-800-874-9375 (M-F 10-5 EST)**1-517-628-2943**

Inquiry 669.

THE BEST OF THE BEST!
Public Domain & User Supported Software for IBM PC or compatible. Word Processing, Database, Spreadsheets, Utilities, Games, Accounting, etc! 60 disk package **$205.00,** or rent 2 wks. **$75.00.** Info & Super Sampler Disk **$6.50,** Deluxe Word Processor **$6.50,** both **$12.00.** MC/VISA

BLUE CIRCLE GROUP, INC.
5253 Chicago Ave. S, Minneapolis, MN 55417
(612) 823-4111

Inquiry 659.

PUBLICATIONS

ARTIFICIAL INTELLIGENCE
Subscribe to the new quarterly publication on AI and personal computing. Annual subscription $19.95
- Feature articles and reviews
- AI programming tips
- Interviews
- Latest hardware and software

Don't miss out. Call or write for more information or send $19.95 for your subscription to PC AI.

PC AI **(602) 439-3253**
3310 West Bell Rd., Ste 119, Phx., AZ 85023

Inquiry 785.

SALES/MARKETING TOOLS

Telemarketing Software $95
TeleMAGIC is the #1 package for people who do business by phone. Super fast auto dialer, instant retrieval by several keys. Huge notepad. Makes "quickie" lists, reports, labels, letters. Utterly simple to use. Incredibly powerful. No copy protection. Interface with YOUR word processor. One billion records. DOS windows. Import-export-mailmerge. 30 day money back guarantee. Corporate license available. Network option. Now used by AT&T, GE, Bell, Sears, hundreds of others. VISA, M/C, AX, COD.

Remote Control
1320 Ocean Ave., Suite E, Del Mar, CA 92014
800-992-9952 **In Cal. 800-992-5228**

Inquiry 735.

SOFTWARE/ACCOUNTING

INCOME TAX SOFTWARE
LOTUS 123, APPLEWORKS, EXCEL spreadsheet templates to calculate your 1986 Federal Income Tax plus a look at 1987 & 1988 tax changes. Lots of Forms and Schedules. IRS accepted printout. $50.00. Quick Delivery. VISA/MC. Orders: (800) 826-7146 UG/Dealer discounts.

ISLAND COMPUTER SERVICES
3501 E. Yacht Dr., Long Beach, N.C. 28461
(919) 278-9483

Inquiry 698.

► TIME & BILLING ◄
400 clients/20 partners/80 job & 40 out of pocket categories/20 areas of practice/fixed fee or hourly/more! Prints billing/statements/aged rec's/more! Free phone support. $149 (VISA/MC/AMEX). MS-DOS/CPM-80. Other original software.
FREE catalogue.

MICRO-ART PROGRAMMERS
614 Alameda Padre Serra, Santa Barbara, CA 93103
(805) 962-0922 (24 hours)

Inquiry 708.

SOFTWARE ACCOUNTING

CUSTOM PAYROLL
All systems have multiple pay categories, calculation of all taxes, user defined deductions, 401(k) handling, many reports, paychecks, W-2 forms, and much more. Custom features are available. Prices start at **$695** for system, manual, and PC Basic source code.

Datasmith, Inc.
Box 8036, Shawnee Mission, KS 66208
(913) 381-9118

Inquiry 674.

1986 INCOME TAX PROGRAM
PC-TAX-MASTER, the complete 1986 Federal Income Tax preparation program for IBM-PC, XT, AT, PCjr and compatibles for only **$95.** Form 1040 with 22 schedules and forms. Menu driven, fast, integrated, easy to use. Prints forms. Free telephone support. Yearly updates, and 15 day money back guarantee. Free pop-up scientific calculator with order.
VISA, M.C., C.O.D. call: **1-800-628-2828** Ext 820
Questions and info call: **1-718-417-0165**

DATAX
1923 Linden Street, Ridgewood, NY 11385

Inquiry 675.

TAX PAK
Schedules A B C D E F G R SE W Forms 1040, 1040A, 2106, 2119, 2441, 2468,3903, 4562, 4684, 5261. Not copy protected — For IBM-PC, 8"CPM (Z80) 8"CPM86 Kaypro IV Morrow MD3. Personal $37, Professional $185 Yearly update $27 & $125. Professional includes: IRS Approved forms, multiple clients, alphanumeric input.

CANDELARIA WORKS
3955 Club Dr., Atlanta, GA 30319
(404) 266-2420

Inquiry 665.

dBASE BUSINESS TOOLS
- General Ledger
- Accounts Recvbl.
- Order Entry
- Sales Analysis
- Purch Ord/Invntory
- Accounts Payable
- Job Costing
- Job Estimating

$99 EA. + s&h w/dBASE 2, 3 or 3+ SOURCE CODE

dATAMAR SYSTEMS Cr. Crd/Chk/COD
6809-B Convoy Court
San Diego, CA 92111 **(619) 278-8222**

ALL FORMS TAX SOFTWARE
- Individual Federal Income Tax Software
- Schedules A-E, G, R, SE, W
- Forms 1040, 1116, 2106, 2119, 2210, 2441, 3468, 3903F, 4136, 4562, 4686, 5695, 6251
- Prints on IRS forms or acceptable format
- BASIC source, IBM PC, XT, AT or Compatibles
- Demo disks $10.00 + 2.50 Shipping

Prices starting at **$39.95**

Unique Computer Systems
140 E. Commonwealth Ave. #208, Fullerton, CA 92632
In CA 1-800-331-5088 **(714) 525-7118**

Inquiry 786.

SOFTWARE BASICS

COMPILED BASIC TOOLS
We now carry a complete line of libraries and tools for Compiled BASIC in addition to our FINALLY! series. Get our catalog of top brand products for Compiled BASIC, by calling 1-800 423-3400 (9:00 AM to 8:00 PM EST)

KOMPUTERWERK, INC.
851 Parkview Blvd., Pittsburgh, PA 15215
PA & AK call (412) 782-0384

Inquiry 703.

SOFTWARE/BUSINESS

IBM/APPLE/MAC SOFTWARE $10/DISK
2,500 Top Titles in Word Processing, Spreadsheet, Graphics, Database, Integrated, etc. Instant Access!
24 hr. Hot Line **800-663-8844** **604-732-7508 In Canada** **Call Toll Free**
to place your order. Super fast 2-day Air Courier Delivery anywhere in North America. Don't Miss Our Limited Time Special: Order 10 Disks, Get 5 FREE! Call now for FREE giant catalog. M/C, VISA, AE, COD

SOFTSAVE

Inquiry 745.

Service Plus—Delivery Rating
Complete set of programs for delivery services. Rates bill using your rates, zones, wt. breaks, etc. from simple rating to multiple zones, types. Reports include invoicing, driver pay, sales by customer tonnage reports, aged receivables, statements, custom labels and more.
Demos $19.95 Full System $495.00

SRI CORP.
P.O. Box 70012, Houston, TX 77270
(713) 864-5285

Inquiry 753.

PC-CHECKBOOK
Total checking at your fingertips! Quick & easy to use. Version 3.0 include: Auto Filing, 1000 Entries/Checkbook, File protection, Check Editing, Sorting by Date & Check No., Analysis Report. Screen Print, Sequencial & by Category. POP-UP Prompters & Full Screen Help Menus. May be used as a Budget Manager. **$39.95** chk/MC/VISA.

DEB/SOFT APPLICATIONS
P.O. Box 35398, Houston, TX 77235
(713) 729-2362

Inquiry 677.

PC-Write™ Shareware Ver. 2.7
Fast, powerful word processor/text editor for IBM PC. Spelling checker, screen clip, mailmerge, split screen, ASCII files, macros. Supports proportional printing, laserJet, 300+ printers. **$16** for all software, tutorial/guide on diskette. OK to copy. Register for manual/support, **$89.** Full 90-day guarantee.

Quicksoft **(206) 282-0452** **Visa/MC**
219 First N. #224J, Seattle, WA 98109

Inquiry 732.

DATA ENTRY SYSTEM
Heads-down data entry with two-pass verification for the PC/XT/AT & compatibles. Loaded with features like: Auto dup & skip, verify bypass, range checks, & table lookups. Fully menu driven **only $395.**
Call for free 30 day trial period.

COMPUTER KEYES
21929 Makah Rd., Woodway, WA 98020
(206) 776-6443

dFELLER Inventory
Business inventory programs written in modifiable dBASE source code.
dFELLER Inventory $150.00
Requires dBASE II or III, PC-DOS/CPM
dFELLER Plus $200.00
with **History** and **Purchase Orders**
Requires dBASE III or dBASE III Plus (For Stockrooms)

Feller Associates
550 CR PPA, Route 3, Ishpeming, MI 49849
(906) 486-6024

Inquiry 686.

THE BUYER'S MART

SOFTWARE/BUSINESS

Service Plus Inventory II

Inventory location & control for warehouse & distribution centers. Fast, comprehensive & guaranteed to increase productivity. Handles 1000s of product codes (SKUs) each having as many locations as needed. Many reports including full activity by product codes, picksheets by FIFO, lot #, serial #, or expir. dates. Demos available **$19.95** Full system **$695.00** Add'l modules available. Requires Harddisk IBM XT, AT or compatible multiuser or single user available.

SRI CORP.
P.O. Box 70012, Houston, TX 77270
(713) 864-5285

Inquiry 752.

THE EXECUTIVE™ VERSION 2.4

Organize yourself! The Executive integrates a customizable rolodex with activities by name, autodialing, calculator, calendar with alarm & word processing with inside calculations. Mail merge your rolodex entries. 140 p. user manual . 30 day guarantee. $79

EXECUTIVE MASTERY SOFTWARE
P.O. Box 578-C, Concord, CA. 94520
orders
(415) 680-0202 (800) 682-2860

Inquiry 766.

LP88-LINEAR PROGRAMMING

A powerful menu-driven system for solving linear programs w/ up to 510 constraints & 2510 variables. Features include interactive & batch operation, spreadsheet-style input & editing, storage of problems & bases, Simplex Algorithm restart, report generator, sensitivity analysis. Req. IBM PC, 192K. $99 w/8087 support, user's guide. VISA/MC.

EASTERN SOFTWARE PRODUCTS INC.
P.O. Box 15328, Alexandria, VA 22309
(703) 549-5469

Inquiry 680

CASH PLUS

A complete set of programs to help small business people track sales and receivables efficiently. Reports include: Aged Receivables, Statements, Cash Due today or future date, Sales by category, customer, YTD, custom labels, and much more. Add on modules available.

Demos $10.95 Full System $89.95

SRI CORP.
P.O. Box 70012, Houston, TX 77270
(713) 864-5285

Inquiry 751.

SOFTWARE/CHURCH

Church Package

Parishioner Time, Talent and Treasure System program is written in modifiable dBASE source code.
• Contributions • Disbursements • Ledger
• Names with mailing labels
• Personal information database.
Requires dBASE II or III. PC-DOS/CPM-80 $200.

Feller Associates
550 CR PPA, Route 3, Ishpeming, MI 49849
(906) 486-6024

Inquiry 685.

ROMAR CHURCH SYSTEMS™

Membership-61 fields plus alternate address; labels, letters, reports any field(s). Offering-256 funds; optional pledge; statements; post to 255 x/year. Finance-G/L with budget; up to 500 sub-totals & 99 depts: month & YTD reports anytime for any month. Size 2000 people/floppy; 25000/10 meg. Ad too short! Write!

Romar Church Systems, Attn: BMB
P.O. Box 4211, Elkhart, IN 46514
(219) 262-2188

Inquiry 737.

SOFTWARE/EDUCATION

BENZENE RING SUBSTITUTION

This *unique* benzene functional group substitution program is an ideal learning/teaching aid for high school or college chemistry students/teachers. Menu selection provides for 1000's of substituted benzene molecules. Display of molecule and nomenclature. IBM or compatible. $35 + $2 s&h.

PCO DIGITAL SCIENTIFIC
P.O. Box 613, Gurnee IL 60031
(312) 473-1804

Inquiry 720.

SOFTWARE/ENGINEERING

ENGINEER'S AIDE

Integrated Process Engineering Software

- Pipeline/Ductwork Sizing
- Pump/Fan/Compr. Sizing
- Heat Exchanger Sizing
- Orifice/Control Valve Sizing
- Project Financial Analysis
- Conversions/Specifications

Pull-down menus, pop-up help, money back guarantee. All for $395 (IBM & Macintosh).

Engineering Programming Concepts
P.O. Box 925, Camarillo, CA 93011,
805-484-5381

Inquiry 683.

Affordable Engineering Software

CALL OR WRITE FOR FREE CATALOG
Circuit Analysis • Root Locus • Thermal Analysis • Plotter Drivers • Graphics • Signal Processing • Filter Design • Report Proofreader • Transfer Function Analysis.

BV Engineering
2200 Business Way Suite 207, Riverside, CA 92501
(714) 781-0252 VISA/MC

Inquiry 662

CONTROL YOUR PROJECT!

Describe the work, **MicroGANTT®** project management system calculates the schedule and budget. Optimize the schedule and resource loading interactively. Customize the reports, including Gantt Chart and Network Diagram. Buy only the modules you need. MS-DOS, PC-DOS & CP/M-80. Free catalog.

Earth Data Corporation
P.O. Box 13168, Richmond, VA 23225
(804) 231-0300

Inquiry 679.

ELECTRONIC CIRCUIT ANALYSIS

ECA-2 is a PC based high performance analog circuit simulator w/AC, DC, Transient, Fourier, Worst Case and Monte-Carlo analysis. **ECA-2** will handle circuits of approx. 500 nodes and 2500 components. In addition to value and tolerance, the component parameters include Bandwidth, Temperature Coefficient, Delay, Phase Angle and continuous or piecewise non-linearities. Includes component sweeping for optimization. Demo disk **$15. ECA-2 $675.** One year update service **$120.**

TATUM LABS
POB 698, Sandy Hook, CT 06482
(203) 264-3755

Inquiry 757.

FINITE ELEMENT ANALYSIS

MSC, the leader in FEA technology, markets a full line of FEA tools for personal computers. Starting at $45 for MSC/pal INTRO on either the IBM PC or the Apple Macintosh, our products are designed to be complete and easy to use. Interfaces for most CAD systems available.

The MacNeal-Schwendler Corporation
815 Colorado Blvd. Los Angeles, California 90041
(213) 259-3888

Inquiry 707.

SOFTWARE/GENERAL

SongWright III

Music Processor for IBM Compatibles

Prints quality lead sheets, songs, scores with text and symbols, multiple staves; transposes to any key; plays tunes. Screen graphics editor; IBM/Epson/Star printers. Send **$49.95,** $2 s&h or write for free sample output.

SongWright Software
Route 1, Box 83, Lovettsville, VA 22080
(703) 822-9068

Inquiry 748.

SMALL BUSINESS & HOME

Loans/Sav'g/Calculator/Cost Schedule/Help Access List & Search. Files: Create, Read, Add Data-Charge Accts. Budget, Inventory, Tally, Auto Phone, Payroll. Invoice Sales/Ser./Paymts/Rtns. Check/Bank Stmts. Text-File. Sorts. Instrs. List Code-Basic. IBM & Compatible. 256K

$39.95 + $5 S/H COD/M.O./Csh-Chk.

CALC-DATA, INC. 800-247-7893 305-456-0417
460 Tamarind Dr., Hallandale, Fla. 33009

Inquiry 663.

NEW INTEGRATED ENVIRONMENT AI FOR THE IBM PC

TOPSI IS A FULL VERSION OF **OPS5** WHICH RUNS UNDER MS-DOS, UNIX OR CP/M. A FAST, EFFICIENT EXPERT SYSTEM DEVELOPMENT TOOL.

PROTOTYPING: **$125** PRODUCTION: **$250**
PROFESSIONAL: **$375** SHIPPING, ADD **$5**

DYNAMIC MASTER SYSTEMS
POB 566456, Atlanta, GA 30356
(404) 565-0771 **Telex #282923**

Inquiry 678.

GREAT SOFTWARE, *CHEAP!*

Absolutely smashing User Supported Software $4.95 per disk. PC-Outline, AutoMenu, PC-Key Draw, PC-DeskTeam, PC-Write 2.7, Poster-Banner, DOSamatic, utilities galore, games, much more! Money-back guarantee. IBM PC, PC Jr, or compatibles. FREE CATALOG.

SHAREWARE EXPRESS
31877Del Obispo, Suite 102M, San Juan Capistrano, CA 92675

Inquiry 787.

SURPLUS SOFTWARE. CHEAP!!!

NAMEBRAND MS-DOS software at FINAL LIQUIDATION prices. Microsoft Basic Compilers, & Interpreters, Multiplan, dBASE II, CCP/M-86, Wordstar, Spellstar, & Mailmerge. Supercalc 2, Lattice "C", RM Cobol, Realworld General Ledger, Sales Analysis, Payroll, much more! All software is new, in original factory sealed packages. We also have a limited number of manuals for your favorite programs. Plus both new and surplus hardware. Don't miss this one. Send for FREE CATALOG today!!

GIL ELECTRONICS
P.O. Box 1628-C, Soquel, CA 95073

Inquiry 691.

SOFTWARE/GRAPHICS

SOFTWARE/GRAPHICS

LAND SURVEYS

L-PLOT. . . A Metes & Bounds program to plot/print plats of Any scale— *Any* description—use *Any* measurement! Calc. areas, error of closure, plots multi tracts. IBM/compat with monographics, CGA or EGA capability. $190. 30-day *FREE* trial. Visa/MC/chk.

LAN/SCAN, INC.
P.O. Box 6863, Abilene, TX 79608
(214) 824-6419

Inquiry 704.

THE BUYER'S MART

SOFTWARE/GRAPHICS

FORTRAN PROGRAMMER?
Now you can call 2-D and 3-D graphics routines within your FORTRAN program.
GRAFMATIC: 75 callable routines for screen output. **$135.**
PLOTMATIC: Pen plotter driver. **$135.**
For the IBM PC, XT, AT and compatibles. We support a variety of compilers, graphics boards and plotters.
MICROCOMPATIBLES
301 Prelude Drive, Dept. B
Silver Spring, MD 20901
(301) 593-0683

Inquiry 710.

TI PRO + TURBO + GRAPHICS
TIGrafix = graphics, turtlegraphics, music, scr and curs controls, + more. Use basic pics w/o reprog.Source & doc included. TIGrafix **$89.95,** + TURBO w/8087 & BCD - **$169.95.** NEW—TURBOFIX patches IBM TURBO 3.01A to run on TI windows, plot & draw- **$39.95** or with TIGrafix or TURBO **$30.00.** Specify IBM or MS DOS TURBO.
PROWARE, INC.
P.O. Box 15272, Portland, OR 97215
VISA/MC/CHECK 7AM-7PM MON-FRI
(503) 233-4465

Inquiry 728.

GRAPHICS PRINTER SUPPORT
AT LAST! Use the PrtSc key to make quality scaled B&W or color reproductions of your display on any dot matrix, inkjet, or laser printer. GRAFPLUS supports all versions of PC or MS-DOS with IBM (incl. EGA), Tecmar, and Hercules graphics boards. $49.95.
Jewell Technologies, Inc.
4302 SW Alaska St., Suite 207, Seattle, WA 98116
(206) 937-1081

Inquiry 701.

► 4D Laboratory EGA Support
Now you can investigate the fourth spatial dimension with your 16-color 256K EGA. It could change the way you think about 3-D space. Rotate the venerable tesseract (hypercube) and other supplied 4D shapes. Or define your own shapes, controlling the color and placement of each line in the x, y, z, and w axes.
Order today for $44.44 plus $4 S&H, CA add 2.89 tax.
For Compaq, IBM PC, compatibles CGA or 256K EGA
4D GRAPHICS LAB
Suite 537, 12021 Wilshire Blvd., Los Angeles, CA 90025
(213) 479-4792

Inquiry 687.

SOFTWARE/LANGUAGE

SCREEN PROGRAM GENERATOR
SPG I creates BASIC program code quickly and easily. Design your screen directly and SPG I will generate the BASIC program code to handle the display and input of data. Controls use of color, editing, graphics, cursor movement and function keys. Generated code easy to modify / merge / compile. IBM PC & compatibles 128K.
$49.95 + $3 S&H (CA + tax)
Treebeard Software
5901 Warner Avenue, Suite 428, Huntington Beach, CA 92649
(714) 840-6939

Inquiry 763.

HYPER C COMPILERS/TOOLS
Apple II ProDos Professional compiler, CDOS compiler, ProDos entry level compiler, 65C02 Assembly Language Dev. System, Macintosh compiler, full source code for both Apple II and Macintosh programming tools.
For further information/catalog contact:
WSM GROUP, INC. (602) 298-7910
P.O. Box 32005, TUCSON, AZ 85751

Inquiry 768.

SOFTWARE/LANGUAGE

Minnesota **SNOBOL4** *Language*
Powerful string & data handling facilities. Interpreter compatible with mainframe SNOBOL4. 32K strings, 32 bit integers, 8087 for float & large memory model. Sample pgms include ELIZA. For >128K IBM PC & DOS or equivalent. Definitive "green" book by Griswold et al available.
Guide + 5¼" SSDD diskette **$44.95**
Guide + diskette + "green" book **$59.95**
"Green" book only **$26.95**
Postpaid in USA. In NY add tax. VISA/MC **(914) 271-5855**
BERSTIS INTERNATIONAL
POB 441, Millwood, NY 10546

Inquiry 658.

CBTREE FOR C PROGRAMMERS
B-tree ISAM driver written completely in 'C' to K & R standards. Supports multiple keys, variable key lengths, fixed or variable length data records. Easy to use sample programs and quality documentation. Fast, Flexible, Efficient. Source code and no royalties for only $99 plus shipping.
PEACOCK SYSTEMS, INC.
2108-C Gallows Rd., Vienna, VA 22180
(703) 847-1743

Inquiry 721.

FORTRAN UTILITIES
CROSS-REFERENCE UTILITY: Mainframe grade symbol x-ref listing for variables, subprogram calls and labels. Variable map shows type, length, alloc, scope, usage tag, etc. All FORTRAN 77 compilers. **$49.95 + $2.50** S&H.
UTILITY LIBRARY: Assembly language routines for screen, cursor, keyboard, time, sound, etc. MS/IBM and IBM Pro/RM FORTRAN compilers. **$39.95 + $2.50** S&H.
IBM PC with DOS 2.0+. VISA/MC/MO/check (2 wks)
PJN INTERNATIONAL
P.O. Box 201363, Austin, TX 78720
(512) 258-1235

Inquiry 726.

Ada®
◇ **Ada Language Reference Manual** ◇
• Appropriate for any Ada compiler •
• Convenient 6" × 9" format •
• Quantity and educational discounts available, $12.95 (postage included) •
Gensoft Corporation (412) 621-0235
319 South Craig St., Pittsburgh, PA 15213
®Ada is the registered trademark of the United States Government, Ada Joint Program Office (AJPO)

Inquiry 690.

SOFTWARE/SCIENTIFIC

HP-PC HYPER-CALCULATOR
Pop-up MS-DOS programmable scientific calculator emulates HP-11C. Hex/oct/bin arithmetic, two-way data transfer, program & data disk storage, HELP, alpha prompts, 100 registers, 1000 program steps. Free 8087 version, utility programs. **$39.95 + $1** s&h.
SUNDERLAND SOFTWARE ASSOCIATES
P.O. BOX 7000-64
REDONDO BEACH, CA 90277
CALL TOLL FREE **800-628-2828 ext. 502**

Inquiry 750.

DATA ACQUISITION AND ANALYSIS ON PC'S
• MEASURE for Data Acquisition directly to Lotus 123 • FOURIER PERSPECTIVE II advanced Digital Signal Analysis. • LOTUS MANUSCRIPT Technical Document Preparation System. Combines Text and Graphics. • PRIME FACTOR FFT Subroutine Library. Call from Turbo Pascal, C, Fortran, Basic. Up to 65,520 Data Points. 2D available. • TURBO PASCAL from Borland. • TELEVISION for Image Communications. • 8087 Coprocessors, all varieties. • DASH-16 A/D Converter Board from MetraByte.
FREE Customer Service — Satisfaction GUARANTEED
ALLIGATOR TECHNOLOGIES
P.O. Box 11386, Costa Mesa, CA 92627
(714) 662-0660

Inquiry 652.

SOFTWARE/SCIENTIFIC

forMath® text-formatter
• Equations, matrices, ratios, integrals, diagrams
• Macros, fonts, Greek/math symbols
• Hyphenation, secn/eqn/ref numbering
• Indexes, table of contents, footnotes
• Dot-matrix, daisywheel, laser printers, all monitors
$400. $50 for demo
SHANTHA SOFTWARE INC.
50 West 97th St. Room 11N, New York City 10025
(212) 222-SNIP
Touchtone toll free: **950-1088-wait-FORMATH**

Inquiry 741.

SUBROUTINE LIBRARY
Scientific Subroutines for technical programming in Fortran, Pascal, Modular 2 and C. Source and Object code for a variety of compilers. Quality software at affordable prices.
ALPHA Applied Research
2355 McLean Blvd., Eugene OR 97405
(503) 485-6841

Inquiry 653.

FREE ***SCIENCE/ENGINEERING*** **MAGAZINE**
Circle below for FREE sample of *Personal Engineering & Instrumentation News*. Monthly magazine gives News, Reviews and Applications Tips for the Areas of **Analog and Digital Instrumentation, Design Automation and Data Acq & Control**. Subscriptions: $30/yr ($60 outside US)
Personal Engineering & Instrumentation News
28 Rice St., Newton Center, MA 02159
(617) 969-7274

Inquiry 723.

CROSS ASSEMBLERS *for*
VAX VMS *and* ***PC/MS DOS***
New Low Prices
Relocatable Macro Cross Assemblers, Linkers, Librarians
Targeted to almost all Microprocessors
ENERTEC, INC.
BOX 1312, Lansdale, PA 19446
215-362-0966 **MC/VISA**

Inquiry 682.

MATRIX CALCULATOR
Matrix manipulations, Linear Programming, System of Eqns, Multilin Regr., Diff Eqns. Spread Sheet-like Editor/Printer. Free DSIKUTIL software, 160+ pg. manual. **$59.95** Source in Turbo Pascal Option at $60 includes Free Turbo Pascal Linker program.
SoftTech Inc.
14640 LaBelle, Oak Park, MI 48237
1-313-544-8544

Inquiry 744.

Σ Δ = SCIENTIFIC SOURCECODE = Φ δ
Adv. Scientific Analysis & Graphics—see BYTE 9/86 p32
►GRAPHICS: 20 types, block, lin/log, contour, 3D plots.
►PROBABILITY: statistics, mult/poly regression, reliability.
►IMAGING: fft, snr, raytrace, convolve, fractals, autocorr.
►MATRIX ops: inverse, eigenvectors, complex, sim. eqs.
50 CAE tools in Basica. "Elegant code" loaded with graphics tricks; fractals the 4-color limit! Science handbook & disk.
MC/Visa **(800) 541-0900 (800) 334-3030 in CA**
$79 + $3 s&h — **SIMPLICATION UnLtd.**
P. O. Box 654, Menlo Park, CA 94026

Inquiry 743.

THE BUYER'S MART

SOFTWARE/SCIENTIFIC

SCI-CALC

Pop-up scientific expression evaluator, more powerful than other pop-up calculators. Complete expression editing facility. Full range of functions: scientific, statistical, logic. Requires IBM PC compatibility.

Introductory price $79.95

From the producers of SCI-GRAF

Microcomputer Systems Consultants
32 West Anapamu, Suite 190, Santa Barbara, CA 93101
(805) 963-3412

Inquiry 711.

SOFTWARE/UTILTY

EditingTools 2.1

A superb text editor with an intelligent DOS shell. Load multiple directories as menus. Edit multiple files. Move text among files. Don't use your PC without it. Only **$35.** + $4 s/h. Optimized Turbo Pascal source code optional.

Jou Laboratories
P.O. Box 460969, Garland, TX 75046
214-495-8862

Inquiry 702.

UTILITIES

IBM PC, DOS 2/3 70 KB

We print pictures (300 + pic. maker enclosed) mixed with multifonts on **Toshiba, Epson,** etc. OR run our mem. resident calendar, calculator, DOS services etc or even YOUR own codes.

What can't it do? at **$45** US?

LCS **(514) 279-5678**
P.O. Box 956, Outremont, Quebec
Canada, H2V 4R8

Inquiry 705.

SOFTWARE/SORT

OPT-TECH SORT/MERGE

Extremely fast Sort/Merge/Select utility. Run as an MS-DOS command or CALL as a subroutine. Supports most languages and filetypes including Btrieve and dBASE. Unlimited filesizes, multiple keys and much more! MS-DOS **$149.** XENIX **$249.**

(702) 588-3737

Opt-Tech Data Processing
P.O. Box 678 - Zephyr Cove, NV 89448

Inquiry 716.

STATISTICS

NUMBER CRUNCHER STAT SYS

Menu-driven. Multiple & stepwise regression, ANOVA, time series, discriminant cluster and factor analysis, principal components, scatter plots, histograms, t-tests, contingency tables, nonparametrics. Import export data. Spreadsheet, sort, join, merge. **$79.** IBM PC/MacIntosh. Quantity discount.

NCSS-B
865 East 400 North, Kaysville, UT 84037
801-546-0445

Inquiry 712.

PRINTER! CACHE! RAMDISK!

PRINT-matic ($16) sends predefined control codes to any printer from within applications AND allows you to change fonts while printing. **WARP-TEN** ($16) is a programmable disk cache that speeds up your PC disk accesses. **RAMbak** ($16) automates the saving of new or changed RAM disk files to floppy disks and/or hard disk subdirectories. PC, XT, AT, compatibles with 256K DOS 2.0+. (MN Res. + 6%). NCP

Software Brewing Company
P.O. Box 12094, St. Paul, MN 55112
612-636-2727 **Visa/MC/CHK**

Inquiry 747.

SOFTWARE/STATISTICS

P-STAT®

Full mainframe package for PC/XT/AT & compatibles. Statistics, data & file management, data display, report writing and survey analysis all in one. 4GL programming language, online HELP & EDITOR, command or menu driven. $95 demo and site license available.

P-STAT, Inc. **(609) 924-9100**
471 Wall Street, P.O. Box AH, Princeton, NJ 08542
Telex: 466452

Inquiry 729.

STATISTICS CATALOG!

If you need statistics for IBM PC or Apple II, call us and let our technical advisors help you find the statistics programs you need.
Write or call now to get a FREE catalog of statistics and quality control software.

HUMAN SYSTEMS DYNAMICS
9010 Reseda Blvd., Ste. 222
Northridge, CA 91324
(800) 451-3030 **(818) 993-8536 (CA)**

Inquiry 695.

FILE GENIE™

File Genie™ is a file conversion system which gives you the necessary tools to easily analyse and convert any file to a new structure. Ideal for re-structuring unusable data or word processing files. Search and replace in multiple files using "wild card" file descriptions. MS/PC-DOS. $69.95 M/C VISA

TEAM AUSTIN, INC.
6809 Convoy Ct., San Diego, CA 92111
USA 800-822-0852 **(in CA) 800-822-0853**

Inquiry 758.

SOFTWARE/TOOLS

dBDOCGEN™
dBASE™ DOCUMENTATION GENERATOR

dBASE owners easily document your dBASE applications. Documents .DBF (with structure and field names), .NDX (with index), .CMD, .FRM, and .FMT files. Only **$99.50** + $4 UPS Gnd or + $6 Blue S&H VISA/MC

CALL TODAY **(503) 233-8676**

TOP PRIORITY Data Products, Inc.
1731 S.E. 55th Ave., Portland, OR 97215-3396

Inquiry 760.

STATISTIX™

$75 - Satisfaction guaranteed

A comprehensive, powerful, yet easy-to-use statistical analysis system for IBM PC/XT/AT's, Apple II's, and MS DOS machines. Clear 200p manual. Write for information.

NH ANALYTICAL SOFTWARE
801 West Iowa Aver, St. Paul, MN 55117
(612) 488-4436

Inquiry 714.

HANDS OFF™ PC SECURITY

- Locks Hard Disk. - Restricts Floppy Use.
- Protects Subdirectories.
- Normal Use of DOS Commands and Application Software.
- IBM PC, XT, AT and True Compatibles.
- DOS V2.0 and Higher. Hard Disk System.
- Keep Other Peoples HANDS OFF Your System
- **$89.95** VISA/MC

SYSTEM CONSULTING, INC.
314 Canterbury Dr., Pittsburgh, PA 15238
(412) 963-1624

Inquiry 754.

Modula-2

REPERTOIRE is the fastest selling M2 toolkit. New release includes DBMS, screen system, editor, & 250+ routines. **$19** for all LNKs & SYMs; **$89** with full (560K) source and 300p printed manual. MC/VISA/AMEX/COD/PO. Call for free demo & manual on disk. Logitech & other versions.

PMI 4536 SE 50th, Portland, OR 97206
(503) 777-8844; BIX: pmi

Inquiry 727.

The Statistician

includes: Multiple Regression (Stepwise, ridge, all subsets, backward elimination)

- Time series analysis • descriptive statistics
- transformations • survey research • nonparametrics
- X-Y plots • ANOVA • random samples • data base
- data editor • search & sort • hypothesis tests

For IBM, MS-DOS, XENIX, CPM, TRS-DOS.

QUANT SYSTEMS
Box 628, Charleston, SC 29402
803-571-2825

Please call **TOLL FREE 1-800-334-0854 (Ext. 814)**

Inquiry 730.

SOURCE CODE LIBRARIAN & REVISION CONTROL SYSTEM

TLIB™ keeps ALL versions of your program in ONE compact library file, even with hundreds of revisions.

- 5 times faster than SCCS • LAN compatible
- Free public domain **MAKE** (with source) by L. Dyer

MS/PC-DOS 2.x & 3.x. **$99.95** + $3 S&H. VISA/MC

BURTON SYSTEMS SOFTWARE
POB 4156, Cary, NC 27511
(919) 469-3068

Inquiry 661.

SCREEN MASTER

For business professionals, programmers and home users

Create demos, prototypes, tutorials, w/384 color combinations & animation. Capture screens from programs. Design menus instantly. Enhance high level languages w/23 utilities. Run-time module for distribution. Simple enough for anyone — complex enough for any job.

***GENESIS* DATA SYSTEMS**
5403 Jonestown Road, Harrisburg, PA 17112
(717) 652-1200

Inquiry 689.

RATS! Version 2.0

RATS, the best selling Econometric software package, now includes daily and weekly data, a new easier to use 500 page manual, and many advanced features. Use RATS for time-series and cross-section regression, including OLS, ARIMA, VAR, logit, and probit. IBM PC or compatible. $200. MC/VISA. Call for brochure.

VAR Econometrics, Inc.
P.O. Box 1818, Evanston, IL 60204-1818
(312) 864-1910

Inquiry 765.

PADLOCK/PADLOCK II DISKS

PADLOCK furnishes the user with a method for providing protection against unauthorized duplication from DOS commands **$99.** PADLOCK II disks come preformatted with finger-print and serialization. PADLOCK II disks offer superior protection. Ask about our HARD DISK protection with uninstall capability. MC/VISA.

GLENCO ENGINEERING
3920 Ridge Ave., Arlington Hts., IL 60004
(312) 392-2492

Inquiry 693.

THE BUYER'S MART

UTILITIES

PAL FOR SIDEKICK!
Personal Appointment Locator automatically shows coming appointments, searches your file, maintains to-do list, automatically repeats appointments, examines multiple files. Resident alarm too! Only **$49.95.** Cheap at twice the price!

PAL SOFTWARE
Ste. 12B 110 Green St., New York, NY 10012
212-334-9172 **1-800-541-0900**
(In CA.) 1-800-334-3030

Inquiry 718.

UTILITIES

Protect your hard disk data!
Second Chance protects hard disk data files by making fast reliable backups. Second Chance is from Quaid Software, the makers of CopyWrite, so you can count on the same reliability speed and ease of operation you're used to with CopyWrite. MS-DOS **$75** U.S. Check/Credit card.

QUAID SOFTWARE LIMITED
45 Charles St. E. 3rd Fl.
Toronto, Ontario, Canada M4Y 1S2
(416) 961-8243

UTILITIES

Recover deleted files fast!
Disk Explorer now includes automatic file recovery. You type in the deleted file's name, Disk Explorer finds and restores it. Disk Explorer also shows what's really on disk; view, change or create formats, change a file's status, change data in any sector. MS-DOS **$75** U.S. Check/Credit card welcome.

QUAID SOFTWARE LIMITED
45 Charles St. E. 3rd Fl.
Toronto, Ontario, Canada M4Y 1S2
(416) 961-8243

VIDEO ANIMATION

Video Animation
Would you like to do real animation on video tape? The Pico Systems Video Animation Controller and an editing video recorder are all you need. Any computer with a spare RS-232 serial port can run this controller. No special software; just simple words and numbers command the controller to insert n frames of video from your screen to an exact location on the tape, with absolute frame accuracy guaranteed.

Pico Systems
819 Marshall Ave., Webster Groves, MO 63119
(314) 962-6103

Inquiry 724

AT'S DON'T NEED 360kB DRIVES
The 1.2mB drive has long been known to READ but NOT reliably WRITE on 360kB floppies. With "**CPYAT2PC**"™ 1.2mB drives CAN reliably WRITE 360kB floppies saving a slot for a second hard disk or backup tape. "CPYAT2PC" (Not Copy Protected) offers 'the preferable SOFTWARE SOLUTION. *ONLY $79+$4* S/H VISA/MC/COD UPS B/R

MICROBRIDGE COMPUTERS
655 Skyway, San Carlos, CA 94070
Order toll free **1-800-621-0851 x777**
415-593-8777 (CA) **212-334-1858 (NY)**
TELEX EZLNK 62873089 Dealer inquiries invited

Inquiry 709.

CONCURRENT DOS BACKUP
BackPack™ runs like BACKUP/RESTORE and supports DOS and CP/M media as well as users. Backs up and restores up to 1000K/min. on an AT and 360K/min. on an XT. Supports release 4.1. Also available on CP/M-80 and CP/M plus. **$150.**

Bright Light, Inc.
520 Fellowship Rd. #C301, Mt. Laurel, NJ 08054
(609) 778-0772

Inquiry 660.

WORD PROCESSING

HEBREW / GREEK / ARABIC
Russian and European Languages. Full featured, multi-language word processor supports on-screen foreign characters with no hardware modifications. $350 (dot matrix) or $500 (laser) + $5 s/h. Or send $15 + $4 s/h for demo. Req. 512K/graphics

Gamma Productions, Inc.
710 Wilshire Blvd., Suite 609, Santa Monica CA 90401
(213) 394-8622

Inquiry 688.

Advertise your computer products for
as little as **$375** in THE BUYER'S MART.
For more information call
Karen Burgess at BYTE **603-924-3754.**

TRI STATE COMPUTER

160 BROADWAY, NEW YORK, NY 10038
(Bet. Maiden Lane and Liberty St.)
(212) 349-3134 • Open weekdays 9–6, Sunday 10–4

CALL TOLL FREE ORDERS ONLY 1-800-221-1926

MC & VISA ACCEPTED
NO ADDITIONAL CHARGE



TOSHIBA T3100
in stock..... **3299.99**

IBM AT HARD DISK
512k 1.2 drive 20 MB HD
IBM keyboard.. **$2595.95**
IBM AT 512k 1.2 drive **$2199.99**

IBM XT New Model 268
256K, 1-360K drive, keyboard & controller **$999.95**
As above w/20 MB **$1899.95**

AT&T 6300
128K-1360K drive, monitor w/keyboard..... **$1449.95**

PANASONIC BUSINESS PARTNER AT FX 800
512K exp. to 8 MB 1-1.2 drive, 20 MB HD **$1899.95**

PANASONIC BUSINESS PARTNER XT FX 600
256k expandable to 640k
1-360k drive, 20 MB HD **$1095.95**

SHARP PORTABLE
PC 7000..... **$749.95**
MACINTOSH Plus **$1599.95**
MACINTOSH 512K
800k Drive.. **$1299.95**
TOSHIBA T1100 Plus
w/640k..... **$1599.95**

MODEMS
Hayes 1200... **$349.00**
Hayes 2400B.. **$499.00**

EPSON EQUITY I
256K, 2-360k drives, with monitor & video card, DOS & Basic, parallel & serial ports..... **$849.95**
As above w/1-360K, 1-20 MB, Hard Drive. **$1099.95**

EPSON EQUITY II
640K/2-360K Drive **$999.95**

EPSON EQUITY II
640K/360K Drive
20 MB Hard Drive
w/mono-monitor. **$1399.95**
w/color-monitor. **$1599.95**

EPSON EQUITY III
640K, 1.2 Drive, 20 MB **$2195.95**

PRINTERS
Apple Imagewrtr II. **459.95**
IBM Pro Printer XL **489.99**
IBM ProPrinter... **349.99**
New Epson LX86. **209.95**
Epson DX 35..... **479.95**
Epson LX 80..... **139.95**
(Homewriter 10)
Epson LQ 800.... **479.95**
Epson LQ 1000... **679.95**
Epson EX 800 (new) **439.95**

PRINTERS
Epson EX 1000... **529.95**
Epson LQ 2500... **969.95**
Pana. KXP 1092.. **269.95**
Pana. KXP 1592.. **379.95**
Pana. KXP 1595.. **509.95**
Pana. KXP 3131.. **229.95**
Pana. KXP 3151.. **359.95**
Oki ML 192..... **269.95**
Oki ML 192 Plus.. **339.00**
Oki ML 292e..... **379.95**
Oki ML 293e..... **499.99**
Oki ML 193 Plus.. **499.95**
Toshiba P321 P/S. **409.95**
Toshiba P341.... **549.95**
Toshiba P351 P/S. **899.95**
NEC P6..... **409.95**
NEC P7..... **585.95**
Silver Reed EXP 800 **619.95**

LASER
HP Laser Jet.... **2250.50**
HP Laser Jet Plus **2995.95**

Epson FX 86E.. **339.95**
Epson FX 286E. **479.95**
Epson FX 286.. **429.95**
Pan. KXP 1080i. **179.95**
Pan. KXP 1091i. **229.95**

SOFTWARE
Bank St. Writer.... **49.95**
Crosstalk XVI..... **99.95**
D'Base III Plus... **384.95**
DAC Easy 'Account'g **47.95**
R. Base System 5. **329.95**
Fast Back..... **89.95**
Flight Simulator... **32.95**
Framework II..... **384.95**
Lotus 123 v. 2.01.. **284.95**
Manag'g your Money **106.95**

SOFTWARE
Microsoft Windows.. **67.95**
Microsoft Word... **279.95**
Multimate 3.3..... **229.95**
*Advantage..... **279.95**
Superkey..... **39.95**
PFS Professional File **187.95**
PFS Professional Write..... **147.95**
Sideways..... **39.95**
New! Twin..... **69.95**
Typing Tutor III..... **34.95**

New Version
WordPerfect 4.2... **199.95**



All items subject to availability and price changes. Mail and phone orders C.O.D., MC and VISA, S&H extra. Not responsible for typographical errors. All systems fully tested and installed by Tri State Computer. Printer price w/purchase of cable only. **Special to BYTE readers — Full Size Printer Stand $9.95**

Inquiry 314

YES, YOU CAN!

PC AMERICAN MAKES IT POSSIBLE FOR YOU!

MULTITECH 900 10/6 MHz Compatible Computer — $1500



- 10 or 6 MHz
- 1.2 MB Floppy
- Keyboard
- MS DOS 3.1
- 5 Half-Height internal Drive slots
- 1 Year Warranty
- Serviced Nationwide by TRW
- 512K expandible to 1 MB

Multitech Options

- Software monitor and monochrome graphics card . . $219
- Color monitor and gr. card . . . $399
- EGA monitor and EGA card $659
- Multifunction, EMS, 0-1.5 MB . $219
- Daughterboard to wxpand to 3 MB $128

IBM Compatible Computers

PCAM
20MB Turbo System
(4.77/8MHz XT Compatible) 640K, 360K Floppy, 20MB, AT Style KBD, One Year Warranty
FCC Approved **$895**

PCAM
30MB Turbo System
(4.88/8MHz XT Compatible) 640K, 360K Floppy, 30MB, AT Style KBD, One Year Warranty
FCC Approved **$955**

Desktop Computer



IBM PC AT 512K 2395
Compaq Deskpro 386/40MB 4900
IBM PC XT 256K 1150

Transportable Computer



Compaq Portable 256K . . . 1595
Compaq Portable + 20MB 1995

Floppies

Fujitsu 360K 80
Toshiba 3½" 720K 139
Teac 360K 89
Teac 1.2MB/FG 129
Toshiba 360K 99
Toshiba 1.2MB 129

Alternative Mass Storage

Archive 20 Internal Tape . . . 456
Archive 60MB Internal 695
Archive 60MB External 695

Diskettes and Tapes

DC600A 27
Maxell MD2-DM 10 disks . . . 19
Maxell MD2-HD 10 disks 35

Hard Disk Drives

Seagate ST225, 20MB Kit . 368
Seagate ST238, 30MB Kit . 459
Seagate ST251 40MB Kit . . . 669
Seagate 4038 30MB 569
Seagate 4051 40MB 669
Seagate 4096 80MB/ software 1049
Western Digital 1002 125
NCL (like WD 1002) 82
Western Digital WAH 189
NCL (like WD WAH) 154
Western Digital WA2 239

Hard Cards

Maynard 10MB 499
Maynard 20MB 599
Maynard 30MB 799

Input Device

Microsoft Mouse 119
Mouse System Mouse 139
Mach III Joystick 33
Game Card 44

Graphics Board Monochrome

Hercules Graphics Card 194
Everex Edge 239
ATI...Mono/color/high/res . . 239
Clone monochrome graphic . 95
Persyst Bob/MG mono/RGB . 171

Printer–Dot Matrix Near Letter Quality



Epson LX 86 245
Epson EX 85 379
Epson FX 286 525
Epson EX 800 579
Epson EX 1000 797
Epson LQ 2500 1095
IBM Proprinter 399
Citizen 120D 120 CPS 189
Panasonic 1091 I 240 CPS . . 377
NEC P6 XL 216 CPS 24 wire 478
NEC P7 216 CPS 24 wire . . 680
NEC P5XL 290 CPS 24 wire 988
Toshiba P-321 216 CPS 434
Toshiba P-341 216 CPS 632
Toshiba P-351 288 CPS 933
Toshiba P-351 C 288 CPS . 1153

Printer–Laser

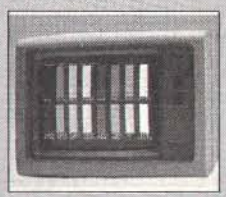
Toshiba Page Laser
12 pages per minute, 6 times product life
300 DPI . . . . . CALL
H P Laserjet 3845
H P Laserjet Prof 2345
H P Laserjet Plus 2995
Cannon LBP-8A-1P 1898

Monochrome Monitor

Thompson 4508 132 column, 14" **$165**

Samsung monochrome 79
Multitech softwhite 119
Multitech 14" reversable . . . 159

Color Monitor



Thompson Color 640/200 . 269

EGA Color Monitor

NEC Multisync **$565**

Princeton PL-14 770x400 458
Sony Multiscan 1302 629
Thompson Ultrascan 579
Multitech EGA 399

Lap-Top Computer



T1100+ (640K, 2 3½" Drives, 720K) **$1750**

T3100 (640K 3½", Floppy/10MB Hard, 720K) **$3500**

Zenith 181 (640K 2 3½", Floppies, 720K) **$1845**

NEC Multispeed (640K 2 3½", drives, 720K) **$1595**

Graphics Board Color

Hercules Color Graphics 149
Clone Color Graphics/Port . . . 78

Graphics Board EGA

ATI Wonder 299
Paradise EGA/Auto Switch . . 365
Video 7 Deluxe/Auto Switch . 389
AST 3G Plus 640x350 367
Epic EGA EGA/CGA 235
NEC EGA for Multisync 399
Multitech EGA 249

Modem



US Robotics Direct 1200 Ext 109
US Robotics 1200 Internal . . 115
US Robotics 2400 Internal . . 189
US Robontics 2400 External 348

Memory Expansion

AST Premium 256K 289
Multifunction six pack 78
AST Rampage PC 256K 234
AST Rampage AT 512K 445

Power Supply

150 Watt/135 Watt 69/59
Ruby Surge Protector 59
Backup Power Supply 800W 663

Dos

Microsoft MS DOS 3.2 79

Key Boards

Ketronics 5151 158
Keytronics 5153 254
Maxiswitch (like 5153) . . . 129
Clone AT Style Keyboard . . . 69

Chips

256K 150 Nano 27
256K 120 Nano 29
64K 150 Nano 9
8087 119
8087-2 8MHz 166
8087-3 5Mhz 117
80287-3 5MHz 189
80287-8 8MHz 299

Accounting

Dac—Easy Accounting 43
Open System, Accounting . 399
BPI Accounting 295
Computer Associates 349

Data Management



dBASE III Plus, Ashton T . . . 399
R Base 5000, Microrim 308
Reflex, Borland 98
Paradox Ansa Software 442
Cornerstone 69

Desktop Management

Sidekick, Borland 49
Deskview 63

File Management

PFS First Choice 95
PFS Professional File 145
PFS Professional Write 128

Desktop Publishing

GENIUS full screen monitor 1330
click Art Personal Pub 115
ScLaser Plus 344
PageMaker/Aldus 495
Harvard Professional Publish 435
Polaroid Palette 1589

Cad/Cam

Pro Design II 173
Generic Cad 99

Games

Flight Simulator, Microsoft . . 32
Jet, Sublogic Communication 33
F-15 Strike Eagle, MicroPro . 29

Integrated



Framework II 425
Symphony, Lotus 425
1-2-3, Lotus 305
Enable, The Software Group 368
HAL 115

Investment

Dollars & Sense **$94**
Managing Your Money **$117**
Dow Jones Market Analyzer + **$269**
Dow Jones Market Manager + **$189**

Programming Language

Turbo Pascal w/8087 BCD . . 58
Turbo Prolog, Borland 58
Microsoft Quick Basic 72

Project Management

Harvard, Project Management 299
Microsoft Project 238

Tax Planning or Preparation

Tax Preparer, HowardSoft **$199**
Chipsoft Turbo Tax Personal **$48**
Chipsoft Turbo Tax Pro **$288**
Turbo Tax State **$145**

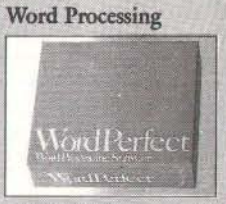
Real Estate

Real Estate Portfolio **$328**
Real Estate Analyzer III **$225**
Good Buy **$229**
Good Lease **$229**

Utilities

Norton Utilities, Norton 51
Carbon Copy, Meridian 130
PC Tool, Central Point 39
Mace Utilities 45
Lightning 54
Disk Optimizer 29
Software Carousel 29
Double Dos 29
V Feature, Golden Bow 145
SQZ! 59
Double DOS 33

Word Processing



WordPerfect 4.2 219
Microsoft Word 3.1 287
Easy, MicroPro 88
Webster Spell Checker 37
Wordstar 2000+ 278

The difference between **PCAmerican** and other suppliers is our service. We guarantee low prices, carry products that are fully backed by manufacturer's warranties and offer customer service and technical support.

Yes you can! It's easy to do business with PC American. We offer terms to qualified institutions, accept major credit cards, wire transfers, checks, and cash.

Yes you can! Give us a call. Let us make it possible for you.

TERMS: We accept cashier check, Money Orders, Visa, Master Card, 3% extra on American Express, wire transfers, qualified P.O.'s and C.O.D.'s. All equipment carries new factory warranty. Prices are subject to change. Any return item must be accompanied by a return authorization number and description. IBM, Compaq, Seagate are registered trademarks of their respective companies.

HOURS
MONDAY — FRIDAY
8:30 — 5:30
SATURDAY
10:00 — 2:00

pcAmerican
Marketing, Inc.
17151 Newhope St., Suite 104, Fountain Valley, CA 92708

1-714-557-3903
CUSTOMER SERVICE
Inquiry 220

1-800-654-5365
SALES HOTLINE

1-714-557-3904
TECHNICAL SUPPORT

¢ompu$ave

Call Toll Free: 1-800-624-8949

A DIVISION OF ADLANKO CORPORATION

PRINTERS

Canon LBP-A1	**1935**	Alps P2000	**699**
CIE Triprinter	**1395**	CIE LIPS-10	**2345**
Citizen MSP10	**269**	Citizen MSP20	**309**
Citizen Prem.35	**459**	**Citizen 120D**	**175**
Genicom 5010	**2365**	Fujitsu 2600	**1255**
Toshiba Laser	**2499**	**NEC P6**	**428**
Panasonic 1080i	**195**	NEC P7	**609**
Panasonic 1091i	**258**	NEC CP6	**539**
Panasonic 1092i	**CALL**	NEC CP7	**729**
Panasonic 1595	**565**	Okidata 192+	**CALL**
Printronix L1012	**CALL**	Okidata 294	**CALL**
Diconix: 150 cps/ Portable/ 4 Lbs			**329**
Laser Printer Headquarters			**SAVE**
Data Products/Data South/Diablo			**CALL**
Epson/Juki/Qume/Star/Televideo/TI			**CALL**
Buffers/ Cables/ Sheet Feeders			**SAVE**
Stands/ Switch Boxes/ Tractors			**SAVE**

MONITORS

Mitsubishi 6922	**2125**	**Amdek 410**	**158**
Mitsubishi 8918	**2875**	Aydin 19"EGA	**1995**
NEC Multisynch	**555**	Goldstar RGB	**259**
Packard Bell EGA	**415**	Samsung TTL	**82**
Sony Multiscan	**CALL**	**Taxan 840**	**849**
Wyse 700 W/Card	**699**	Thomson 450A	**165**
Taxan 760: 14" EGA & 560 Auto Card			**659**
Hitachi/Panasonic/PGS/Teco/Zenith			**CALL**

COMPUTERS

AT&T 6300/1 Drive	**1295**	Laser 128/Ap	**382**
Sharp PC7000	**985**	Wyse 286/1.2M	**319**
Toshiba T1100 +	**1675**	Wyse 286/20M	**2145**
Toshiba T3100	**3195**	**Zenith 181**	**1675**
Cordata PC: Port.& Desk/ 2 Drives			**895**
Cordata AT: Port./ 1.2 M Drive			**1595**
Packard Bell AT: 640K/ 44M Drive			**2195**
Packard Bell AT: 640K/ 72M Drive			**2595**
Panasonic Business Partner: 2 Drives			**849**
Panasonic Business Partner: 20M Drive			**1149**
Panasonic Bus.Partner 286: 1 Drive			**1429**
Panasonic Bus.Partner 286: 30M Drive			**2039**
Panasonic Executive Partner: 2 Drives			**1675**
Panasonic Senior Partner: 1 Drive			**1065**
Sperry IT: 1M/ 44M Drive			**2799**
Wyse + Turbo: 640K/ 2 Drives			**1025**
Wyse + Turbo: 640K/ 20M Drive			**1475**
Altos/Corvus/ITT/NEC/Televideo/Others			**CALL**

TERMINALS

Adds 20/20	**419**	Altos V	**CALL**
Freedom I Turbo	**429**	Ampex 232	**485**
IBM 3164 Color	**899**	**Wyse 30**	**289**
Kimtron KT7	**419**	Wyse 50	**369**
Televideo 905	**285**	**Wyse 60**	**408**
Televideo 955	**399**	Wyse 85G	**432**
Hazeltine/Liberty/Link/Visual/Zenith			**CALL**

PLOTTERS

Houston 41/42	**2325**	Hewlett 7475	**1575**
Houston 51/52	**3295**	Hewlett 7570	**4449**
Houston 51/52MP	**3695**	Ioline 4000	**4295**
Houston 56A	**4195**	Roland 800	**CALL**
Calcomp 1041GT	**5295**	**Roland 880**	**879**
Calcomp 1043GT	**7295**	Roland 980	**1165**
Gould/Taxan/Other Makes & Models			**CALL**

DIGITIZERS

Calcomp 44x60	**4995**	GTCO: All	**CALL**
Hitachi 11x11	**585**	Kurta Penmouse	**185**
Hitachi 15x15	**1195**	Kurta 12x12	**499**
Houston TG1011	**499**	**Kurta 12x17**	**559**
Houston TG1017	**595**	Kurta 36x48	**3595**
Houston TG8036	**2845**	**Summa 12x12**	**379**
MS BUS Mouse	**109**	Summa 12x18	**659**
Mouse Systems PC Mouse / Serial			**119**
Many Other Models And Mice			**CALL**

MODEMS

Prometheus 1200	**272**	**AT&T 4024**	**472**
Prometheus 2400G	**255**	Hayes 1200	**365**
Ven-Tel 2400 +	**372**	Hayes 2400B	**535**
Zoom 1200ST	**189**	Zoom 1200XL	**229**
Anchor Volksmodem 12/ External & PC			**118**
Anchor Lightning 2400/ External & PC			**295**
Incomm 2400: Upgradeable 4800+			**295**
Prometheus 1200B: With Software			**125**
Racal-Vadic 2400/ External & PC			**409**
US Robotics Courier 2400			**378**
Codex/Novation/Rixon/Toshiba/UDS			**CALL**

BOARDS

ATI EGA Wonder	**272**	Grappler +	**69**
Orchid Turbo PGA	**999**	**Taxan Gold**	**319**
PC Parallel Port	**35**	PC Serial Port	**35**
Taxan 560 EGA	**319**	Tecmar EGA	**265**
Tseng EVA 480	**382**	Vega Deluxe	**359**
Alloy or Adv.Digital Slave Boards			**CALL**
Aristocad: Pro-To-Go II			**695**
Artist 10: 1024x1024 (Interlaced)			**2145**
AST Advantage: Premium 512K			**449**
AST Rampage: PC-XT/ 256K			**275**
ATI Graphics Solution			**175**
NEC GB-1 Board (Multisynch)			**385**
Genoa/Hercules/Number Nine/Quadrum			**CALL**
Sigma/STB/TAT/Verticom/Vutek			**CALL**

WE ALSO CARRY MANY OTHER PRODUCT LINES & MODELS, CABLES, SOFTWARE CHIPS, KEYBOARDS, POWER DEVICES

DISK DRIVES

Seagate 4038	**559**	Seagate 251	**669**
Seagate 4096	**1125**	Seagate 4051	**699**
Seagate 20M Kit	**369**	**Priam ID-130**	**2495**
Seagate 30M Kit	**412**	Toshiba 3.5"	**119**
Apple & IBM Compatible Drives			**SAVE**

OTHER FLOPPY AND HARD DRIVES
Alloy • CDC • CMS • Corvus • Fujitsu
Genoa • IOMEGA • Irwin • Mitsubishi
Maynard • Miniscribe • Mountain • Teac
Peachtree • Maxtor • Tandon • Titan
Tallgrass • Tecmar • Western Digital

HOURS: MON - FRI 7AM - 6PM/SAT 9AM - 2PM
IN ARIZONA CALL (602) 437-4855

CompuSave: 4207 S. 37th St., Phoenix, AZ 85040/Prices Reflect Cash Discounts And Subject To Change Without Notice. Major Credit Cards And Selected PO's Are Accepted. We Cannot Guarantee Compatibility.

Soft*Rite ⟩⟩ LANbasic!

Soft*Rite announces a *Superior* three-part programmer's tool. MicroSoft BASIC™ compatible in every place that counts. *

LANscreen

LANscreen makes the burden of defining your database record structures one that you will look forward to instead of dread. Standard fields and types such as "Money", "Telephone" and "Date" are one keystroke to generate. As many as 255 database structures can be related to a single screen! Segmented data input can be done automatically by editing the field display. Part numbers with spaces or dashes and slashes are automatically parsed down to the essential raw data. Definable Upper and Lower limits for numeric inputs along with ACCEPT/EXCEPT input filters are standard features. Screen Mask generation is done with a "freestroke" approach. You may put mask elements and data input/output cells wherever you wish. COLOR them too! EGA support too!

*Drivers Installed for IBM PC-NET/MS-NET

LANbasic

LANbasic is your own personal solution to powerfull data manipulation. How many times have you got excited over some new "total" database package only to find out (after spending a fair amount of time and money) that you were stuck in some corner, unable to do some function that has become standard in "**I**n **B**usiness for **M**oney's" Basic? The manual is 400 pages long, so we cannot fully describe all the features, but here are a few in ADDITION to the ones you are now used to:

★ COMDATA$ 14 common areas ALWAYS available to inside or outside, chained or linked programs ★ Re-assignable printer ports LPT1 -LPT4 ★ Generic filename use that allows file and database locations to be re-defined outside of basic in a user-created REDIRECTOR file, to ease multi-user system configuation ★ USESCREEN,<1-16> ★ SCREENINPUT,<anyfield> ★ SCREENOUTPUT,<anyfield> ★ OPENDB,<remote or local database manager> ★ DBGET,<variable from DBM, automatically defines and dimensions in LAN basic> ★ DBPUT,<same>

LANdbase

LANdbase is the home for your data. LANbasic calls are coupled to LANdbase via network comunications (PCnet or ?). A single keyvalue and function number will return a record. Multiuser record locking is handled by simply putting an 'X' after the read call. (i.e. RDDBEQUX,<argument>. Automatic "health checking" to warn you of poor hardware performance and lost or fragmented data. "Paranoid" mode of operation where files not accessed for some time will be closed and reopened to flush buffers and insure integrity. Password, Userlevel and Data encryption functions. Several DBM's can be installed in the network system to improve performance and reliability. Toggle mode screen (printer) reporting to record log-on or other access activites. Bill Fairman's tried and proven true C-Tree(c) data management product.

Soft*Rite Multi-User Programming Tools
15381 Chemical Lane, Huntington Beach, CA. 92649
(714) 898-0525

IBM SOFTWARE

OVER 10,000 IBM/COMPATIBLE PUBLIC DOMAIN PROGRAMS AVAILABLE FROM OUR "NATIONAL SOFTWARE LIBRARY"

ONLY $3.99

More Word Processors (120): Includes Zuri,Qedit,E88,XE, and PC-Fedit
Dogstar with Castle (258): Adventure and Wumpus
Golfcard (259): Keeps score for 1 or several golfers. Prints interesting reports
Beyond the Titanic (262): Another adventure game.
Pc-Golf (263): Helps you keep score and evaluate your game
Football Fun (264): This disk lets you manage a football betting pool
Trivia Machine (265): Yet another trivia game
Stonehenge BBS (330): Another Bulletin Board Program
ROS 3.3 BBS (335)
Collie BBS (338)
NoChange BBs software (340-342)
MultiComm (343): this communi- cations software can handle many BBS numbers
Communications utilities (345): for the technical
PIBTERM (346-347): Source code for this communications program (Two disks)
Silc-Works (508): this spread- sheet has an information filer, a letter writer, and a communications program
LotusFinancial Utilities #1 (610): Track your investments and IRAs, perform refinancing analyses. (Requires Lotus 1-2-3)
Symphony macro conversion aids (611): Requires Symphony
Lotus ASCII utilities (613): Allows all codes and embedded printer controls, etc., Requires Lotus 1-2-3
123/Symphony Programming Tools (619): Has a utility called Decode which creates an anaslysis of a 1-2-3 or Symphony worksheet. Requires either Lotus 1-2-3 or Symphony .
Lotus Financial Utilities #2 (622): Calculate proforma income statements, track your income and more. Requires Lotus 1-2-3
1-2-3 (624) Cash flow ledger
Virtual Spreadsheet (625): Virtual memory for 1-2-3 version 2.0 & Symphony. Requires either Lotus 1-2-3 or Symphony
Artmaster (726): User friendly graphics program
Mapmaker (727): Helps you draw maps. It requires monochrome and color monitors and cards
Vincent (728): Use ASCII graphics to make drawings
Graphics Sampler (729): This disk has several small graphics programs including 3dplot, Saturn, World Map, and others
Magic Keypad (730): This is a screen design/slide show program
Kraft Paint (731): This graphics program requires a joystick
Pictures(733): These can be displayed on your screen or your printer, includes Snoopy calendar, pinups, more
YourART version 4.0(734): Allows you to create medium resolution graphics
Altimira(735): a generalized drawing and graphics program
CashTracker 5.15 (830): This disk contains a home accounting program
Micro Accounting System 1.3 (831): Another home accounting program
Banker's Tools(832): Predict bankruptcies, perform risk assessments, and loan analyses
Electrik Check(837): Record your checks and reconcile your account
YackP (838): Combines an address book, home accounting, and home inventory
Transtok(840): Load stock data from the source, and then analyze.
MCBS(841): A GL program fo a business
Home Budget Management (844): Home accounting program
Business disk(845): Budget and finance programs as well as a depreciation program
GO General Ledger 1.1 (846): Accounting program for the home or small business
Checkmate(848): Checkbook program with a reconciliation feature
PC-Deal(849): Accounting package features double entries; works well for small businesses
CBASE1.0 (921): Database program
Omaha Database Program (922): Allows multiple data files which can be linked together
Keep-In-Touch (923): Database manager helps maintain information about people
PDBL 2.5 (924): Database includes communications, a label maker and more.
XY (1006): Performs curve fittings, will also plot points onto your CRT or printer. Includes version for 8087 Math co-processor
Probability and Statistics (1007): Fit curves, calculate probabilities and distributions, etc.
Statistics Plotting (1008): Contains plotting programs
BASIC subroutines (1110): Various utility subroutines: Change sub directories, read directory, read/write screen, more
Swiss Army Knife (1112): Some BASIC programming tools
BASIC compiler tools (1113): Includes program squeezer
BASIC general tools (1114): Compare files, unprotect "protected" BASIC files, design the screen, make flowcharts, more
WHIZZARD SCREEN I/O (1115): Fast screens for BASIC
Turbo Pascal (1217) Games/utilities (requires Turbo Pascal)
TSCRIPT And Turbo DEBUG (1218): Helps you shake the bugs out of your Turbo programs
New Fonts (1221): Has Turbo source for creating your own fonts
PXL: 1.21 (1222): Pascal cross reference lister
Expert Systems (1223): Written in Pascal
TurboIO (1224): Pascal routine for I/O
Source Examples (1307): Written in MicroSoft "C"
Source Examples (1308): Written in Desmet "C"
C2dBASE (1309): For dBASE users who like "C"
Source Examples (1310): Written in Lattice "C"
YACC (1311): Yet Another Compiler Compiler
Fifth 2.1 (1408): A programming language like Forth
Assembler Routines (1504): For BASIC (source code only)
Monitor utilities(1505): source code only (Assembler)
Source code only (1509): For batch file utilities (Assembler)
WASM (1511): Assembler
Device Drivers (1512): For printing on COMPAQs
A86 2.16 (1513): Excellent assembler
Source code (1514): For communications utilities
PC/370 Assemble (1517): Link and run IBM 370 Assembly Language programs
Source Files (1520): For DOS utilities
MUMPS 4.03 (1609): Programming language
Programming Tools (1611)
Programmer's Guide (1612): Tips for writing and marketing your applications
ICON (1613/1622/1623) Programming language (three disks)
dBASE III routines (1614): Over 60 dBASE III routines (Requires dBASE III)
Global Concordance (1615): Lists all global symbols in your applications
dBASE II programs (1616): For accounting, mail labels, form letters, and more (Requires dBASE II)
Augusta (1617): Small ADA compiler
MUMPS (1617): Data manager runs under MUMPS (see disk 1609 for MUMPS)
Astrology 9.0 (1714): Calculates and analyzes zodiacs
TV Schedule (1715): Make a viewing schedule for your favorite programs, plus a video tape log
PC Calculator (1716): This calculator resides in memory
Database Publisher (1723): Prints a catalog of your products. Can handle 1000 items
Allwat (1724-25): For engineers that analyze water and distribution systems.(two disks)
Manager's Planner (1726): Calendar program for managers
Applications for the home (1727): Includes HEATCALC, a list of toll free telephone numbers, and a home inventory program
Recipe CookBook (1728): Manages your recipes
Bowling Secretary (1730): Keep records for your bowling league
GSDRAW/GSMAP (1731): Helps you to draw geological maps. Requires digitizer, and HP plotter
DataBridge Labeler (1732): Makes labels
Church Membership (1733): This application helps your church track membership information, and print labels and reports
ListMate (1734): Mailing list program that's compatible with Multimate
MAXI-C.R.A.S. (1810): This disk has a Check Register Accounting System
Program Wizard (1907): Another DOS menu program
More DOS utilities (1912): Includes Other, Mjog. Grep, and many more
Qfiler 2.1E with WFU (1914): Both programs are file managers
DIR Scanner 2.12 (1917): DOS "shell" program. Handles subdirectories and files quite well
Batch Commander (1918): DOS shell
QSYS 3.0 (1919-1920): Complicated DOS menu program with many features (two disks)
File directory listers (1921): Several sorted directory programs
Eshell (1922): Recall DOS command and edit them. Also has EZDOS
DMDOS (1923): File manager works with a mouse, and allows you to view two directories at once
Tracer (2303): Uses the LDS PAF system
Progenitor (2304): Genealogy program
Genealogy 4.0 (2305): Create, edit, and print your family tree
French Language Teacher (2522)
Video Chem (2523): Teaches about chemistry
Beginning Spanish (2524): Habla espanol?
German Language (2526): Tutorial
World (2527): Draws maps of all parts of the world
More BASSIC tutorials (2528): Includes PC-BASIC Review, Poughkeepsie, and more
PFSA (2529): Performs large algebra problems. (Requires 8087 co-processor)
TVS a programmer's editor (2712): Could be used as a word processor as well
WordStar Utilities #1(2810): Index files, convert files saved in document mode to non-document mode, and includes patches for some printers
Neat (2811): Text formatter/printing program
FORMIT (2813): A very powerful text formatting program
Word Processing Utilities (2815): Includes word counter and a simple spell check program
Lincomatic Banner Maker (2916): Allows your banner to use multiple fonts
FontGen (2917): Create fonts for Epson FX, IBM, Proprinter, or compatible printers
File Utilities (3108): Contains utilies to modify sectors on the disk, individual files, etc.
Hard disk Backup Utilities (3109): Better safe than sorry. This has several hard disk backup programs
MasterKey (3110): Like Norton Utilities, only better!
PAL 1.4 (3209): This program makes Sidekick even more powerful. (requires SideKick)
Blaque Book 2.0 (3210): Helps you keep track of names and addresses
Personal Datebook (3211): Another appointment calendar program
Batch File Utilities (3303): Add new features to batch files
Z8OMU 3.1 (3438): Run Z80 programs under PC DOS
EGAutilities (3439): Pallette-setting, 43 line mode pitches, NANSI.SYS **Commando (3440):** DOS file handler. Can manipulate squeezed files and files in .LBR format
Print-To-Disk (3441): This disk has 12 different programs that print to disk. Some have source code.
Disk drive utilities (3442): Includes a RAM disk, a cache program, a fast format program, and more
Utilities for advanced users (3443): with technical information
EGA demos (3444): Show off the capabilities of your EGA board and monitor with this demo program
Keyboard Utilities (3445): This disk has several keyboard utilities including speedkey, ScrollK, KBFIX, and CED

ALL PROGRAM DISKS SHOWN ABOVE ARE NEW THIS MONTH
NOW ALMOST 1000 PROGRAM DISKS AVAILABLE

We accept checks (allow 10 days to clear), money orders, Visa Mastercard, American Express, and COD (add 1.90).
Minimum order - 5 program disks. Free catalog upon request

800-992-1992
NATIONAL

U.S/DISK, INC.

800-992-1993
CALIFORNIA

511-104 Encinitas Boulevard, Encinitas, California 92024 ■ Hours: Mon. - Sat. 6:00 am - 4:30 pm Pacific Time

FOLKS DOWN IN TEXAS DON'T LIKE PAYIN' BIG BUCKS ESPECIALLY FOR IBM-PC SOFTWARE SO WE SELL IT FOR ONLY $6.00!

OVER 600 DISKS FULL OF IBM-PC COMPATIBLE PUBLIC DOMAIN AND USER SUPPORTED SOFTWARE.

APPLICATIONS

☐ **GENEALOGY ON DISPLAY** (#90)
☐ **GENEALOGY - FT** (#240) From Pine Cone software.
☐ **LABELMAKER** (#146) Our favorite label file and maker. Menu driven.
☐ **FAMILY HISTORY** (#361) Family history, ancestor and decendant charts. Sample programs.
☐ **FORM LETTERS** (#388) LOTS of samples of the most commonly used business letters. Modify!
☐ **PC-SPRINT** (#507) Detailed instruction on how to double your computer's speed for less that $50.00.
☐ **MSDOS-CPM/80 INTERFACE** (#561) CPM lovers! This program allows you to transfer information between and emulate CPM and MSDOS.
☐ **NAME GRAM/BREAK DOWN/FOREWARD** (#477) Discover the words inherent in your phone number, do great anagrams.
☐ **THE WORLD DIGITIZED** (#494, 495, 496) A cartographer's dream. Locate and display over 100,000 locations.
☐ **100 LETTERS** (#300) Most commonly used from letters, and business applications at your fingertips.

COMMUNICTIONS

☐ **QMODEM** (#310) Without a doubt the fastest and best communications software you can buy at any price.
☐ **PC-TALK** (#16) The classic "Freeware" communication program.
☐ **RBBS** (#212) Become a SYSOP and start a bulletin board.
☐ **FIDO NET** (#333) Bulletin Board System. Perhaps the easiest to run.
☐ **PROCOMM** (#499) Communication software that makes a hacker's dream come true.

DATABASE

☐ **VCR dBASE** (#493) Keep track of those favorite VCR tapes that you never can seem to find when you want them.

DATABASE PROGRAMS

☐ **PC-FILE** (#5)Perhaps the granddaddy of user supported database programs from Jim Button.
☐ **NEWBASE** (#238) Menu driven database for the beginner.
☐ **PC-DBMS** (#383) A relational database management system that provides on-line help and screen editing funcitons.
☐ **CREATOR** (#339) Create, report and sort makes this a super database management system.
☐ **MAIL MASTER** (#481) Easily sort, index, and list your multiple mailing data bases.

EDUCATION

☐ **EQUATOR** (#249) A teaching tool for math, science and finance.
☐ **PC-TUTORIAL** (#403) A first course in computer usage covering various aspects of MS-DOS. Good!
☐ **PC-PROFESSOR** (#105) Learn Basic the easy way. One of the best tutorials on BASIC.
☐ **PC-DOS HELP** (#254) Type "help" for the DOS command you forgot.
☐ **PC PROMPT** (#558) Fascinating on line memory resident DOS helper that also supports BASICA, EDLIN, DEBUG, and TURBO PASCAL.
☐ **PC-SPRINT** (#507) Tutorial on how to triple your PC's speed.

FINANCIAL

☐ **PC-CHECK MANAGER** (#275) Keeps multiple checkbooks in balance.
☐ **TAX FILE DBS** (#295) Tax record keeping system that saves you money on April 15.
☐ **PORTSWORTH PACKAGE** (#101) Evaluates your ever-changing stock portfolios.
☐ **PC-GENERAL LEDGER** (#237) An exceptional accounting system. Used by some CPA's.
☐ **LOAN AMORTIZATION** (#399) For output to screen or printer. Lots of on-line help.
☐ **MR. BILL** (#469, 470) Prepare invoices, client report, audit trail, etc.
☐ **(3) ANALYTIC CALC** (#430-432) 3 disk set. Complete spreadsheet, database, graphics, word processor - fassst!
☐ **(2) PC ACCOUNTING SYSTEM** (#559, 560) General purpose ledger system that includes payroll, depreciation, accounts receivable/payable, inventory, processing 1099's and a good general ledger.
☐ **PC-PAYROLL** (#565) Handle all payroll problems with this complete menu-driven payroll system. Includes taxs, reports, forms, etc.
☐ **(2) SALESEYE** (#501, 502) Never let another prospect or lead get away! Prints memos and letters as well.

GAMES

☐ **TOP GAMES** (#274) The most requested arcade type games.
☐ **ARCADE GAMES** (#293) Another goodie bag of top arcade games.
☐ **PC JR GAMES** (#354) Games that will work only on PC JR. Combat, Dungeons and Dragons, Global Thermonuclear War.
☐ **MISC GAMES** (#390) Good selection of educational, adventure, and arcade games.
☐ **PINBALL RALLY** (#557) You asked for it! Here are three pinball games that vary in complexity, PINBALL, RAIN, TWILZON2.
☐ **DND** (#567) Dungeons and Dragons, this uses text characters instead of graphics.
☐ **REFLEX POINT** (#487) Self styled action game similar to ROBOTECH cartoon series.

GRAPHICS

☐ **PC-KEY DRAW** (#344-345) A small CAD system. Lots of demonstration files.
☐ **PC-PICTURE GRAPHICS** (#136) Drawing package allows you to zoom, color, and store pictures.
☐ **PC-GRAPH** (#418) Allows user to create graphics from PC—File report files.
☐ **PRESENT** (#471) Professional slide shows are a snap with the advanced graphic features of this program. Includes a screen "capture".

LANGUAGE

☐ **CHASM** (#10) Cheap assembler with tutorial.
☐ **XLISP** (#148) Lisp language interpreter.
☐ **PROLOG & UNIFORTH** (#417) Complete with editor and documentation.
☐ **ESIE** (#398) Build and generate an expert system in a flash.
☐ **P-BASIC** (#381) BASICA work-a-like for clones, etc.
☐ **TINY PASCAL COMPILER BUILDER** (#540) Learn to create your own Pascal Compiler and language compiler/includes tutorial.
☐ **SCREENCODE** (#503) Build your screen applications and watch SCREENCODE generate the code for DBASE II and III, BASIC, and more.
☐ **VISIBLE PASCAL COMPILER** (#510) Watch your program step through its routines as you learn to program it in PASCAL.
☐ **EXTENDED BATCH LANGUAGE** (#124) Makes the PC do menial tasks you never thought possible.

MATH AND STATISTICS

☐ **EPISTAT** (#88) Statistical analysis of small to medium-signed data samples.
☐ **STAT-TOOLS** (#509) (1 of 2) Do single size experiments, studentized ranges, caluclate the size of specific sample sizes.
☐ **STAT-TOOLS** (#509) (2 of 2) Do calculations that require the entry of original observations, exact randomization tests, mean squares, etc.

MUSIC

☐ **PC-MUSICIAN** (#127) Compose music on your PC, save and play again.
☐ **PIANO MAN** (#279) Play your keyboard like a piano.

PRINTER UTILITIES

☐ **SIDEWAYS** (#265, 411) Prints text sideways on an Epson printer.
☐ **SETPRTR** (#79) Sets up Epson print from a menu.
☐ **PRINTER UTILITIES** (#411) Smorgasboard of utilities and tools.
☐ **EPSON PRINTER UTILITIES** (#326) Spool, set up routines all designed for Epson codes.
☐ **BANNER** (#386) Make long banners with large letters. Includes MS-FORTRAN source codes.
☐ **WSMX80** (#526) Allows Word Star to print more ways than you imagined on an Epson/Compatible printer. Useful for mathematical and scientific notation.

SPREADSHEET TEMPLATES

☐ **PC-CALC** (#199) Fabulous 123 work-a-like from the author of PC-File.
☐ **(2) LOTUS 1-2-3 TEMPLATES AND MACROS** (#406, 414) Why spend hours writing your macros when these are ready made? Modify them yourself.

TEXT PROCESSING TOOLS

☐ **WORDSTAR AIDS** (#375) Collection of the most useful utilities for the Wordstar user.
☐ **PC OUTLINE** (#414) Create and collapse and outline. Great for plans, essays, etc.
☐ **PC-STYLE** (#505) Better than your high school English teacher! Analyzes your writing ability.
☐ **POLYGLOT & LETTERFALL** (#542) Two educational programs to match sentences, words, and definitions, Q&A's. Typing tutor is great!
☐ **SIDE WRITER** (#523) Print your text files sideways. Allows the 132 column barrier to be broken. Great for large spread sheets.

UTILITIES

☐ **GINACO** (#66) Polished routines written in basic for any beginner or expert. We love it!
☐ **ULTRA-UTILITIES** (#133, 245) Recover lost files, modify sectors, etc. Like Nortons.
☐ **SYSMENU** (#250) Build a menu driven menu system. Excellent for hard disks.
☐ **PC-DESKMATES** (#405) Better than Sidekick and all of the rest of the memory resident desktop utilities.
☐ **ALIGN** (#217) Disk Alignment tool. Needs Cats Eye.
☐ **TOP UTILITIES** (#273) All of the most requested utilities on one disk.
☐ **UNPROTECT** (#414) Various routines to disconnect protection schemes.
☐ **PATCHES** (#376) Make back up copies of some of the most popular commercial programs with this collection.
☐ **DOSMATIC** (#498) Fabulous task-switching and menuing utility that allows several programs to run at once.
☐ **PC-TOOLS** (#536) Lots of useful utilities with both EXE and "C" source code. BROWSE, DUMP, MERGE, WORD COUNT, ROFF, GREP, etc.
☐ **DBS-KAT** (#537) Diskette cataloging system for archival purposes. Database can hold up to 9,999 diskettes and 16,000,000 files.
☐ **STILL RIVER SHELL** (#481) An enhancement of the PC-DOS working enviornment. Faster and uses Key Commands.
☐ **PC-PROMPT** (#558) The on-line mode makes this memory resident utility tops. Great for beginners and advanced users alike.

WORD PROCESSING

☐ **PC-WRITE (2)** (#78) A & B Our most popular full featured word processor that is actually faster than Wordstar. Now with spelling checker.
☐ **DICTIONARY** (#378) Dictionary type spelling checker.
☐ **PC TYPE** (#455) Jim Button's contribution to a full fledged word procesor.
☐ **(2) NEW YORK WORD** (#528, 529) Powerful word processor that creates keystroke macros, split screen editing, mail merge and more. Watch out Micro-Soft.



Please Enclose Check With Order

TOTAL # _____ x $6 = _____

DISK DIRECTORY (Explanation of all files & programs) x $6 = _____

OTHER _____ _____

SUBTOTAL _____

TEXAS RESIDENTS ADD 6 1/8% TAX _____

SHIPPING AND HANDLING (1 @ $1.00 and 50¢ for each additional disk) _____

No COD's or Purchase Orders • U.S. Funds Only
Foreign Orders add $5.00 to all Shipping/Handling
We Warranty All Disks Against Defects In Duplication

SHIP TO: _____

_____

_____

CHARGE MY:

☐ MASTERCARD ☐ VISA

CARD NO. _____

EXPIRATION DATE _____

SIGNATURE _____

LONE STAR SOFTWARE

2100 Hwy. 360, Suite 1204, Grand Prairie, Texas 75050, (214) 647-1010 ©1987 LONE STAR SOFTWARE, INC.

IEEE 488 (GPIB/HPIB)



- ☐ Controllers
- ☐ Buffers
- ☐ Converters
- ☐ Extenders
- ☐ Interface Boards

for PCs, Macintosh, HP plotters, instruments, printers, etc.

Call or send for your *FREE* Technical Guide

IOtech (216) 439-4091

23400 Aurora Road
Cleveland, Ohio 44146

Inquiry 147

P-tral BASIC to Pascal **$179**

TRANSLATOR

Translate your BASIC source programs to Pascal source. P-tral, now available for the IBM PC and compatibles, will translate MS–BASIC/BASICA to Turbo Pascal
(Req Dos 2.0 or later w/ANSI.SYS).

Also available for the Apple II series (incl. IIGS) and converts Applesoft to Apple Pascal.

(212) 206-6490 / 924-0576
WOODCHUCK INDUSTRIES
340 WEST 17TH STREET (#2B)
NEW YORK, NY 10011

Inquiry 335

COMMODORE 128 & CP/M Users

WORDSTAR®

WORDSTAR V. 2.26 or SuperCalc V.1.12 or WORDPAC (incl. Grammatic and Spellguard) or Microsoft BASIC. **$39.00** each

Wordstar/SuperCalc includes a 763 page Osborne System Manual with extensive CP/M Tutorials as well.

Combination: Any 3 above for **$95.00.**
52 Page IBM **PUBLIC DOMAIN** $4.00 List of 13,000 Programs.
Also Catalog P.D. Sofware for IBM Apple, C-64, CP/M, MAC, Amiga, CoCo.
Ask about $25 Special.

$28.00 Mailman Database List Manager, Forth, Version 2.0

800-221-7372 Don Johnson
PDSC-33 GOLD ST.-L3-NYC 10038

Inquiry 239

Get into Animation Desktop Publishing Video Production NOW!

ATTN:
TARGA USERS

Find out about the many options that will turn your TARGA board into a more powerful system.

Benefit from the largest and most knowledgeable TARGA System Integrators. Get the ***Crayon 2.5D*** Animation Program that uses TIPS (No Additional paint program to buy or learn).
Turn your PC into a powerful video system: Paint Box, Rotoscoper, Animator, Titler, Character Generator or Desktop Publisher.
Call: JANE JENKINS today!

Crayon Graphics Center
756 N. La Cienega Blvd., L.A., CA 90069
(213) 657-2322 Fax (213) 657-5658

Inquiry 76

controls up to 4 motors from any CRT, terminal or computer

CENTROID



STEPPING MOTOR CONTROLLER

Now With **Microstepping & Circular Moves**

- **RS232 interface • Accel/Decel**

BASIC Version **$985**
16K BASIC, Battery Backup **$1335**
CNC Version **$1950**
Stepping Motor Tips Cookbook **$8**

CALL OR WRITE
CENTROID (814) 237-4535
Box 739, State College, PA 16804

Inquiry 53

ROMDISK

EPROM AND RAM DISK AND DRIVE EMULATORS
For the IBM PC* and Compatibles

APPLICATIONS

- Diskless control and communications systems
- Dedicated workstations - customized smart terminals
- Industrial control and manufacturing test systems

FEATURES

- Solid state speed, reliability and performance
- Self contained EPROM programming circuitry (simply copy a Master Disk to ROMDISK)
- Emulates a 9 sector, 40 track SSDD or DSDD diskette
- Compatible EPROM, Dynamic RAM and Static RAM versions
- Two autoboot modes and a file mode
- RAMdisk versions are battery backed up
- I/O mapped - does not occupy system RAM space

EPROM version PCA-1 (180K)	$495
EPROM version PCA-2 (360K)	$595
Static RAM version PC SRAM-1 (180K)	$695
Static RAM version PC SRAM-2 (360K)	$995

VISA master card

CURTIS, INC. 22 Red Fox Road
St. Paul, MN 55110 612/484-5064

*IBM PC is registered trademark of IBM Corporation

Inquiry 78

1	Exxon
2	General Motors
3	Mobil
4	Ford Motor
5	IBM
6	Texaco
7	E.I. du Pont
8	Standard Oil (Ind.)
9	Standard Oil of Cal.
10	General Electric
11	Gulf Oil
12	Atlantic Richfield
13	Shell Oil
14	Occidental Petroleum
15	U.S. Steel
16	Phillips Petroleum
17	Sun

27 million Americans can't read. And guess who pays the price.

Every year, functional illiteracy costs American business billions.

But your company can fight back...by joining your local community's fight against illiteracy. Call the Coalition for Literacy at toll-free **1-800-228-8813** and find out how.

You may find it's the greatest cost-saving measure your company has ever taken.

A literate America is a good investment.

Ad Council Coalition for Literacy

ACP Has It All!!

CLOSEOUTS!

PRICED TO MOVE AS IS WHERE IS!

A220 Color/Graphics/Video/Mouse	$ 95.00
SHARP PC7000 Portable	850.00
SHARP PC5000 Laptop	199.00
3M DC100A Data Cartridge	12.85
3M DC300A Data Cartridge	14.85
256K Intelligent Buffer	169.00
Quadboard II w/64K	89.95
Quadlink	169.95
Rixon 1200 Baud Modem (int.)	88.00
STB R10 w/64K	89.95
STB Super Res 400 Color	249.95
Orchid PC Turbo 186 w/128K	199.00
Orchid PC NET Blossom w/64K	199.00
Smith Corona (OEM) Letter Quality Printer	149.00
Q&A IBM Software/New Vers.	249.00
6 Slot IBM Compatible Expansion Box	149.95

WHILE STOCK LASTS!

IF YOU DON'T SEE WHAT YOU NEED...CALL US!!!

IBM® COMPATIBLE CARDS



Largest Selection!!!

A210 Color/Printer/Graphics	$ 69.00
A220 Color/Graphics/Video/Mouse	95.00
A240 Mono/Printer/Graphics	79.00
A250 Mono/Printer/Graphics/132 col.	59.00
NEW! NEW! NEW! NEW! NEW!	
A261 Mono/Graphics/ Printer-Short Card	69.00
A271 EGA/256K RAM-Short Card	169.00
A320 384 Multifunction Card-0K RAM	69.95
A340 Multifunction/Floppy	69.95
A350 640K RAM Card-0K RAM	59.00
A410 Floppy Card-2 Drives	29.00
A410 Floppy Card-4 Drives	39.00
A510 Parallel/Serial/Optional Serial	59.95
A520 Parallel Card	35.00
A530 Serial Card	49.00
A610 AT sMb Multi-function-0K	89.95
A620 AT 3.5Mb RAM Card	89.95
A630 AT Parallel/Serial/Optional Serial	59.00
A640 AT Floppy/Hard Controller	199.00
A650 AT I/O Card-Ser/Par/Clk	55.00
A950 AT Motherboard-0K	399.00
A950 XT Motherboard-0K	99.00
A950 XT Turbo Motherboard-0K	119.00

AST

AT Advantage/0K	SALE! $399.00
AT Advantage/1.5Mb	599.00
AT Advantage/3 Mb	899.00
Rampage AT w/0K	299.00
Rampage AT w/512K	359.00
Rampage AT w/2Mb	549.00
Preview I/O XT/AT	189.00
AST-3G I/O "EGA"	399.00
Sixpack Premium w/256K	339.00
Sixpack Premium EGA	599.00
Sixpack PLUS/0K	169.00
SPECIAL! SPECIAL! SPECIAL! SPECIAL!	
Knight Security Software	149.00
COMBO PLUS/0K	69.00
5251/11	579.00
5251/12	499.00
5251/11 Plus	649.00

COMPUTERS

Zenith Z-148 Bundle	$999.00
Zenith Z-181 Laptop	CALL
Zenith Z-158 XT	CALL
Advanced 286 6/8 MHz AT	CALL
AST Premium AT	CALL
AST Turbo Laser	CALL

DCA

Irma	$789.00

HARDWARE

HAYES (2 Yr. Warranty)

1200 RS-232 External	$375.00
1200B w/SMARTCOM I (INT.)	345.00
2400 RS-232 External	575.00
2400 w/SMARTCOM II (INT.)	525.00
Smartmodem 1200	385.00
Smartmodem 1200B	349.00
Smartmodem 2400 (INT.)	575.00
Smartmodem 2400B	535.00
Hayes Compatible (Ext.)1200B	119.00
Hayes Compatible (Int.) 1200B	99.00
Hayes Compatible (Ext.) 2400B	299.00

HERCULES

Hercules Color Card	$186.00
NEW! NEW! NEW! NEW! NEW! NEW!	
Hercules Plus Graphics	239.00
INTEL (5 yr. Warranty) Above Board PC AT PS	New Price

KEYTRONICS

5150 Keyboard	$159.95
5151 Deluxe Keyboard	189.95
5153 Deluxe Keyboardw/Touchpad	285.95
PC Jr. Numeric Keypad	29.95
Advanced Keyboards	
ACP 5150 Keyboard	58.95
ACP 5151 Deluxe Keyboard	79.95
ACP 5160 AT/XT Keyboard	66.95
ACP 5152 XT/AT Keyboard	79.95

MATH CO-PROCESSORS

8087 (PC/XT/Compaq)	$115.00
80287-2	160.00
80287-6	199.00
80287-8	249.00
80287-10	449.00

MEMORY UPGRADE SETS

64K RAM (150ns)	$ 8.90
64K RAM (120ns)	11.50
256K RAM (150ns)	23.50
256K RAM (120ns)	29.50
256K RAM (100ns)	39.50
1Mb RAM	350.00

MICROSOFT

Microsoft Mouse	$139.00
Microsoft Bus Version	155.00

MOUSE SYSTEMS (3 Yr. Warranty)

PC Mouse w/Paint Plus	$138.00
PC Mouse w/Ready & Paint	148.00
ACP Mouse w/Keyboard	SALE! 99.00

QUADRAM

Silver Quadboard PC/XT	$139.95
Liberty PC/XT 0K	169.00
Liberty 2 Mb	418.00
Quadsprint PC/XT Accelerator	199.95
Quad EMS I/O + 256K	339.00
Quad Amberchrome Monitor	CALL
Gold Quadboard	CALL

PRINTERS

BROTHER

M1109 Dot Matrix	$249.00
M1509 Dot Matrix	399.00

EPSON (3 Yr. Warranty)

EX 800 250 cps/50 cps NLQ	CALL
EX 1000 Wide Carriage	CALL
FX85 160 cps NLQ	389.00
FX286 160 cps Wide	549.00

TOSHIBA

P321 "3 in 1" 24 Pin LQ Printer	$479.00
2P341 24 Pin/216 cps	659.00
P351-C Color	1195.00
P351 Model 2	1075.00
P351 24 Pin/288 cps	945
T1100 & T3100	CALL
Toshiba Color Printer	CALL

LIMITED SPECIAL!
8 PEN PLOTTER

Roland's DXY-800 Flatbed X-Y Plotter, including Parallel/Serial Interface. IBM Compatible formerly sold for $995.00 ..... **NOW ONLY $499.00**

SPECIAL OFFER WHILE SUPPLY LASTS!!

DXY 101 Pen Plotter 299.00

EGA SPECIALS

- EGA Monitor plus Upgrade Card ..... **$519.**
- NEC Multisync plus EGA Card ..... **$749.**

SUPER AT VALUE



SHOWN WITH OPTIONAL MONITOR AND SECOND DISK DRIVE

MONITORS

Amdek 310A TTL	$155.00
NEC Multisync	599.00
Princeton MAX-12 TTL	179.00
Roland's CD240 HiRes Color	359.00
Samsung TTL IBM Green	88.00
Samsung TTL IBM Amber	88.00
TECO CGA Monitor	299.00
TECO EGA Monitor	399.00

TAXAN

760 EGA Monitor 14"	$550.00
660 EGA Monitor 12"	540.00
560 EGA Card w/Autoswitching	299.00
SPECIAL! SPECIAL! SPECIAL! SPECIAL!	
560 EGA Plus EGA Monitor 660 or 760	749.00

MORE EGA...

Advanced EGA/256K/ Short Card	$169.00
ATI EGA Wonder	289.00
Orchid Turbo EGA	CALL
Paradise Autoswitch	349.00
Quad EGA Plus/Quadram	299.00
RIX EGA Paint	59.00

PGA SPECIALS

IBM Professional, Limited Quantity IBM PGA Card. Regular $2995.00 ..... **SALE $995.00**

HARD DISC CARDS

Filecard 10 Western Digital	$299.00
Filecard 20 Western Digital	469.00
Filecard 30 Western Digital	588.00
10 Mb Drive only	149.00
21 Mb XT Subsystem WD	388.00
21 Mb XT Subsystem CMI/Tandon	349.00
21Mb XT Subsystem Seagate ST225	419.00
30 Mb XT Subsystem Seagate ST238	499.00
30 Mb AT Drive (40MS.) Seagate ST4038	599.00
40 Mb AT Drive (40MS.) NEC 5046	699.00
CALL FOR HIGHER STORAGE DRIVES!	

3-1/2" DRIVES

10 Mb 3-1/2" Drive/Rodine equiv.	$188.00
20 Mb 3-1/2" LaPine LT200	299.00
30 Mb 3-1/2" LaPine LT300	359.00

BEST BACK-UP!

Use the same back-up device we use at ACP

AlphaMicro VCR Backup Card	$399.00
AlphaMicro VCR	899.00

DISK DRIVES

ACP IBM Drives DS	$ 69.95
Toshiba FDD4403 3-1/2" w/5-1/2" Bezel	129.00
Toshiba ND04D PC/XT 360K	95.00
Toshiba ND04E-G AT 360K	105.00
Toshiba ND08DE-G 1.2Mb	129.00
TEAC FD-55B	99.00

DISKETTES (BOX OF 10)

DS/DD for PC/XT (40tpi)	
• ACP Generic	$ 6.00
• Verbatim Datalife	16.00
• Maxell MD-2	19.00
• Fuji	16.00
DX/Hi-Density for AT (96tpi)	
• Verbatim	32.00
• Maxel	35.00
• Fuji	26.00
SS/DD for Apple II/etc.	
• Verbatim	14.00
• Maxell MD-1	17.00
• Fuji	14.00
MacIntosh/IBM Conv. 3-1/2"	
• Maxell Mf-2DD	36.00
• Fuji MF-2DD (135tpi)	36.00
MORE ACCESSORIES...	
Flip-Soft (holds up to 75 disks)	14.00
ACP 5-1/4" Disk Holder	9.00
ACP 3-1/2" Disk Holder	12.00
Head Cleaner 5-1/4" or 8"	9.00
PERFECT COMPUTERCARE Kit	29.00

SUPER SALE!

$1899.

List $2995.00

"...combined retail value over $4700! You get...

SHARP "AT" Model 7501K...

(made by the same Mfg. as Epson Equity III)

- 80286 6/8 MHz Switchable
- 512K RAM Expandable to 640K
- Hard Disk Controller • 84 key AT Keyboard
- 1.2Mb Floppy w/Controller • 8 I/O Slots
- Serial and Parallel Ports
- MS-DOS 3.1 & GW Basic included FREE

PLUS...

AST "ADVANTAGE AT® w/3Mb ...List $1745.00

That's right...get a 3Mb factory populated AST Advantage card plus serial/parallel I/O, tested!

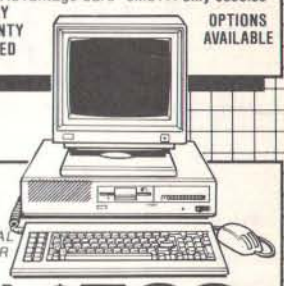
PLUS...

FREE Software including SIDEKICK®, DESQVIEW® and SUPERPAK®

STAND-ALONE PRICES ON ABOVE...

- SHARP "AT" (as above) ..... **Only $1199.00**
- AST "Advantage Card" 3Mb.... **Only $899.00**

FACTORY WARRANTY INCLUDED — **OPTIONS AVAILABLE**



SHOWN WITH OPTIONAL MONITOR

SUPER VALUE! $599.

Advanced PC/XT

...over 4000 Satisfied Customers!

Manufactured by Toshiba. This is the finest IBM compatible manufactured today...we can prove it!

- FCC/UP Approved • (1) 360K Floppy
- Serial/Parallel/LCD • Composite Video
- Mouse & Keyboard • RGB Color Graphics
- 256K easily Expandable to 640K
- 10Mb Hard Disk/ADD $300.



BARE BONES PRICE!!! **$319.**

Advanced 8 MHz XT Turbo

- 4.77/8MHz Switchable • Zinc-lined FCC Case
- 0K, expandable to 640K • 150W Power Supply
- XT/AT Deluxe Keyboard • Phoenix BIOS
- Runs all Major software written for IBM

90 DAY WARRANTY

Advanced Computer Products Inc.

Inquiry 348 for End-Users.
Inquiry 349 for DEALERS ONLY.

TOLL FREE

800-854-8230

CA Residents 714-558-8813

OUR POLICY

- No Surcharge for VISA or Mastercard.
- Volume purchasing agreements available.
- Orders subject to availablity. • Supply limited on certain items.
- Pricing subject to change without notice.
- ACP Retail Store pricing may vary. Not responsible for typos.

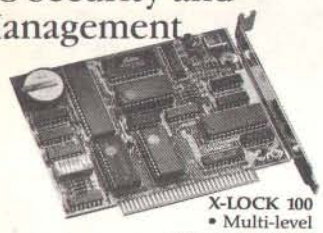
Mail Order: P.O. Box 17329 Irvine, CA 92713

Retail: 1310 B E. Edinger, Santa Ana, CA 92705

CORPORATE BUYERS - CALL GILLES, PHIL, MIKE or DAVE

HACKERS BEWARE!

PC Security and Management



X-LOCK 100
- Multi-level access restriction
- File Protection
- File Encryption
- Complete Usage Reports
- Physical Locking

only $495 ea.

ELECTRONICS INC.

2137 Flintstone Dr. • Tucker, GA 30084
404-491-8044

Inquiry 22

3D INTERACTIVE GRAPHICS

CGS-3 Library for CGA Card

2D and 3D drawing, rotation, scaling, real-time animation. Merge/Copy/Edit images, display images in real-time. Construct/View/Store/Retrieve images. Selective screen filling/scrolling in any direction. Keyboard support. Read/Check keystrokes while program keeps running. Sound/Musical effects. And much more.

Required IBM PC/Compatible/CGA/DOS 2.X,3 X. Support 8087/80287. Callable from MS/IBM Fortran/Basic/Pascal/Profort/Assembler CGS-3 Library + 2D/3D Tutor + 100-page manual **$40**

EGS-3 Library for EGA/Hercules Card

Includes all functions for CGS-3 Library plus: Screen page control. Programmable color palette. Display/Remove text with down-loadable fonts. Draw/Fill with Patterns sized up to 64X64 color pixels. Graphics screen dump.

Required IBM PC/Compatible, 256K EGA or compatible or Hercules Card. Support 8087/80287. Callable from MS/IBM Fortran/Pascal/Profort/Assembler. EGS-3 Library + 2D/3D Tutor + 150-page manual **$65**

LITE-3 Interpreter for EGA/Hercules Card

Interactive Graphics Command Interpreter includes all abilities of EGS-3 Library. Compiling/Linking not required. Single-step graphic command facilities.

Required IBM PC/Compatible, 256K EGA or compatible or Hercules Card. Support 8087/80287. BASICA/Turbo Pascal. MS/IBM Fortran/Basic/Pascal/Profort/Assembler. LITE-3 Interpreter + 2D/3D Tutor + 150-page manual **$70**

Miscellaneous utilities: sound, color, screen dump and much more (from $15) **Call**

Demo (applied toward purchase) $5.00
Please add $3 S/H. TX residents please add 6.125% tax.

Filtrex Research, Inc.
P.O. Box 820425
Houston, Texas 77282
(713) 556-5747
MC/VISA/CHECK/MO

Inquiry 109

SAVE TIME
with
FORMATTED DISKS

"Ready to use in your IBM PC or compatible."



Nashua 48¢

3M 69¢

ALF formats brand-name factory certified disks, and double-checks them for defects. You save the time and hassle of formatting disks yourself, and **pay no more** than for ordinary blank disks!

CALL TODAY TOLL-FREE
1-800-321-4668
in Colorado, 303-234-0871

ALF 1315-F Nelson St. Denver, CO 80215

Inquiry 10



$995

FOUNTAIN-XT COMPUTERS

- IBM COMPATIBLE
- 640 k RAM
- 2-320 k FLOPPIES
- HIGH RESOLUTION MONOCHROME MONITOR
- AT-STYLE KEYBOARD
- PARALLEL PORT
- 8 EXPANSION SLOTS
- GRAPHICS CARD
- CLOCK CALENDAR CARD
- MANUFACTURER'S WARRANTY

AT'S & OTHER CONFIGS. AVAILABLE

H & S SALES, INC.
P.O. BOX 795
RAYMORE, MO 64083

(816) 331-3933

PREPAID ORDERS—NO SHIPPING CHARGES IN USA ONLY
IBM: REGISTERED TRADEMARK OF INTERNATIONAL BUSINESS MACHINES CORP.

Inquiry 129

Universal Graphics Tools for Turbo Pascal

(EGA, Hercules, CGA, HP Laser Jet and plotter drivers and much more...)

No Royalties

The TurboHalo™ Universal Graphics Tools **(Quinn-Curtis Model # IPC-TP-005)** are comprehensive set of over **170** high performance graphics procedures and functions which work with over **41** of the most popular graphics display adapters, dot matrix printers, laser printers, plotters, digitizing tablets and mice. Drivers can be loaded dynamically at runtime, so that your program can support a wide variety of graphics devices without the need to recompile. These procedures take up less than 2K of source code in a Turbo Pascal program. Multiple character fonts, polygons, circles, line styles, area fills, display files, rubberbanding, viewports, device, normalized, and world coordinate systems are all supported. **$130.**

To Order: Call (617)444-7721 or write Quinn-Curtis, 49 Highland Ave., Needham, MA 02194. Mastercard, Visa, Company PO's, Personal checks and COD orders accepted. Add $5 for shipping outside of North America.

TurboHalo is a trademark of Media Cybernetics, Inc.

Inquiry 252

PUBLIC DOMAIN SOFTWARE

isn't copyrighted. Thousands of useful programs available for most computers from user group libraries.

User Group Libraries	Rent	Buy
IBM PC Blue 220 Disks	$230	$450
Capitol-IBM 45 Disks	50	105
Sanyo UG MSDOS 80 Disks	85	225
Authors Showcase (IBM) 35 Disks	40	140
Amiga 50 Disks	65	200
Atari ST 55 Disks	75	220
Macintosh 85 Disks	90	255
CP M UG 92 Disks	45	249
SIG M UG 270 Disks	175	330
CBM 64 Gold 50 Disks	105	150
Apple DOS 120 Disks	130	200

MASTER CARD • VISA • DINERS • AMERICAN EXPRESS

Rental is for 7 days with 3 days grace for return. Use credit card, no deposit! Call for free catalog or send Disk for free Directory of programs. Specify Computer!

24 HR RECORDING (702) 794-3660

PUBLIC DOMAIN SOFTWARE INTEREST GROUP INC.
2400 Santa Rita
Las Vegas, Nevada 89109
702 732-0169
800 527-3744

BBS NUMBER (702) 794-3665

Inquiry 216

3M DISKETTES — LIFETIME WARRANTY

3M

Call For Quantity Discounts

5¼" Disks		Data Cartridges		3½" Disks	
S-Side D-Den	7.95	DC 100A	12.95	S-Side	13.95
D-Side D-Den	9.95	DC 1000	12.95	D-Side	19.95
S-Side 96tpi	15.75	DC 300A	16.60	8" Disks	
D-Side 96tpi	19.75	DC 300XL	19.55	S-Side S-Den.	15.40
HIGH DEN.	21.95	DC300XLP	19.85	S-Side D-Den.	18.95
		DC 600A	22.00	D-Side D-Den.	20.95

HEAD CLEANERS 12.75 EA. 30 Cleanings

Old Resalable

the Diskette Connection™

Delaware 1-800-451-1849 P.O. BOX 10247, WILMINGTON, DE. 19850
Oklahoma 1-800-654-4058 P.O. BOX 1674, BETHANY, OK. 73008
Nevada 1-800-621-6221 P.O. BOX 12396, LAS VEGAS, NV. 89112

Minimum Order $25.00 Visa, MasterCard accepted · C.O.D orders add $3.00 · Surface Shipping on 3.5 or 5.25" add $3.00 per 100 disks. 8" add $4.00 per 100 disks. UPS delivery only. U.S. mail for APO, FPO, AK, HI or PR add an additional 5% for P&L. Prices subject to change without notice!

Verbatim®

WITH "ANTI-STATIC" DATAHOLD PROTECTION

QUANTITY DISCOUNTS

5¼" Diskettes

S-Side D-Den. 7.95 min. 3 bx. | D-Side D-Den. 9.95 min. 3 bx.

S-Side 96 tpi 15.75 | D-Side 96 tpi 18.75 | High Den. 20.95

3½" Diskettes

S-Side 12.95 D-Side 17.95

8" Diskettes

S-Side S-Den. 15.40 | S-Side D-Den. 17.95 | D-Side D-Den. 20.95

Old Resalable

the Diskette Connection™

Delaware 1-800-451-1849 P.O. BOX 10247, WILMINGTON, DE. 19850
Oklahoma 1-800-654-4058 P.O. BOX 1674, BETHANY, OK. 73008
Nevada 1-800-621-6221 P.O. BOX 12396, LAS VEGAS, NV. 89112

Minimum Order $25.00 Visa, MasterCard accepted · C.O.D orders add $3.00 · Surface Shipping on 3.5 or 5.25" add $3.00 per 100 disks. 8" add $4.00 per 100 disks. UPS delivery only. U.S. mail for APO, FPO, AK, HI or PR add an additional 5% for P&L. Prices subject to change without notice!

dysan Dysan® CORPORATION

QUANTITY DISCOUNTS

5¼"

D-Side D-Den. 17.95 | S-Side 96tpi 19.95 | RX 50 Format 20.95 | D-Side 96tpi 21.95 | HIGH DEN. 23.95

8"

S-Side S-Den. 17.95 | S-Side D-Den. 19.95 | D-Side D-Den. 22.95

"Bernoulli" TRI-PACK 8" Disk Cartridges

10 meg. 46.95 EA. | 20 meg. 71.95 EA.

Old Resalable

the Diskette Connection™

Delaware 1-800-451-1849 P.O. BOX 10247, WILMINGTON, DE. 19850
Oklahoma 1-800-654-4058 P.O. BOX 1674, BETHANY, OK. 73008
Nevada 1-800-621-6221 P.O. BOX 12396, LAS VEGAS, NV. 89112

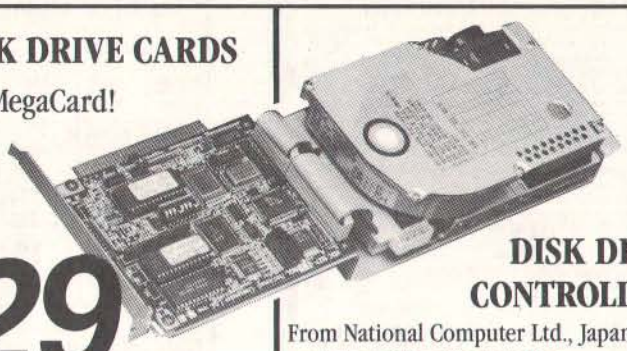
Minimum Order $25.00 Visa, MasterCard accepted · C.O.D orders add $3.00 · Surface Shipping on 3.5 or 5.25" add $3.00 per 100 disks. 8" add $4.00 per 100 disks. UPS delivery only. U.S. mail for APO, FPO, AK, HI or PR add an additional 5% for P&L. Prices subject to change without notice!

HUNTING FOR A GREAT DEAL?

HARD DISK DRIVE CARDS

Logic Array MegaCard!

21-Megabyte



NEW!

$429

- Hard disk drive on a plug-in card gives PC or compatible the storage capacity of an XT
- Uses NEC technology for high reliability
- Fast, easy installation
- **two year guarantee**—parts and labor

21-Megabyte $429
30-Megabyte $479
40-Megabyte $649
40-Mb AT MegaCard $749

HARD DISK DRIVE KITS

(Half height, boots from hard disk—includes controller, cables, manual)

20-Megabyte $375
30-Megabyte $410
40-Megabyte $555
50-Megabyte $675
80-Megabyte $799
(with Disk Manager software)

FLOPPY DISK DRIVES

360-K $89
1.2 Megabyte, AT-Compatible $129
1.2 Megabyte, PC-Compatible
(enables your PC or XT to read and write AT-formatted diskettes)
was $299—clearance price NOW $129



DISK DRIVE CONTROLLERS

From National Computer Ltd., Japan's premier maker of controllers

- These compact AT-compatible controller cards are among the smallest available.
- Co-resident, IBM-COMPATIBLE

NDC 5126 AT Winchester only $179
(a half card—so small you won't believe it's AT-compatible)
NDC 5125 AT Winchester/Floppy $189
NDC 5127 XT Winchester only $79
NDC 3011 SASI Controller $91
Double your drive capacity with the
LOGIC ARRAY KXP 230Z $199



BOARD LEVEL PRODUCTS FROM MYLEX

Multifunction card
0-K $82
384-K $123
Envision I (mono/color/graphics) $147
Envision II (mono/color/graphics, char. RAM enhanced modes) $156
Color Adapter I $77
Business Master I (mon/par adapter, enhanced text modes) $80
Business Master II (high-res. mon graphics, enhanced text modes) $91
Enhanced Graphics Adapter $279
(EGA, CGA, MDA, HGC compatible)

CHIPS

256K D-RAM (set of 9) $27
64K D-RAM (set of 9) $9
V-20 (8 MHz) $10.95

INTEL MATH CO-PROCESSORS

8087 . . . . . $125
8087-2 . . . . . $179
80287-6 . . . . . $225

MODEMS

1200-Baud external, Hayes-compatible, uses AT command set $99

SOFTWARE

Rix EGA Paint $49
On Track Disk Manager $65

HERE'S HOW TO ORDER:

We accept Visa, MasterCard and American Express (no surcharge) and Money Orders. Minimum charge card order $25. No sales tax outside California. (CA residents add 6%.)

Personal or company checks require three weeks to clear.

We insure all orders.

Shipping and handling minimum $5 up to 3 lbs. within continental U.S. Call for shipping info on other orders.

Prices and availability may change.
Returns require authorization and are subject to restocking charge.
Normal manufacturers' warranties apply.
Not responsible for typographical errors.
IBM, MultiSync, MegaCard, Mylex EGA Paint and On Track are trademarks of their respective companies.



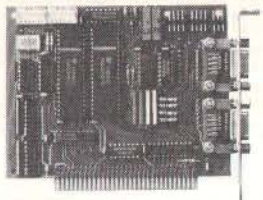
18017 Skypark Circle, Suite L, Irvine, CA 92714

CALL 800-443-7355
In Calif. Call 800-345-4868
Customer Service and Local Sales **714-250-3386**

MON–FRI 7AM–5PM Pacific Time

Inquiry 138

RS-422
Communications Board



- For IBM-PC/AT/XT and compatibles
- Dual RS-422/RS-485 interface
- Differential drivers to 4000 ft.

Fast Delivery

QUA TECH, INC.

478 E. Exchange St. Akron OH 44304
(216) 434-3154 TLX: 5101012726

Inquiry 243

Incredible!

64K Printer Buffer with cable

$69 Plus $3 shipping & handling

30-day money back guarantee plus 1-year warranty



Works with any standard Centronics parallel interface • Reset button • Multiple copy repeat function • Auto diagnostics • Self-test

Order by Check/MO or VISA/MC/AX

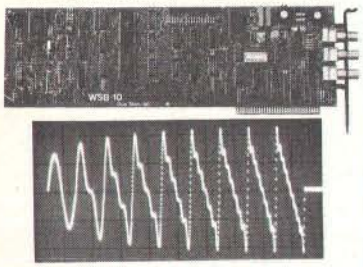
CENTRAL COMPUTER PRODUCTS

Call Toll Free
USA: 800-533-8049
CA: 800-624-5628

330 Central Avenue • Fillmore, CA 93015

Inquiry 52

WAVEFORM SYNTHESIZER



- For IBM-PC/XT/AT and compatibles
- Generates user-definable signal
- Up to 2000 points per envelope

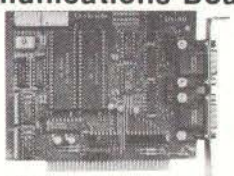
$795.00

QUA TECH, INC.

478 E. Exchange St. Akron OH 44304
(216) 434-3154 TLX: 5101012726

Inquiry 244

RS-232
Communications Board



- For **IBM-PC/XT/AT** & comp.
- Dual RS-232C interface
- Optional software supports COM1, COM2, COM3, COM4
- Jumper selectable interrupts

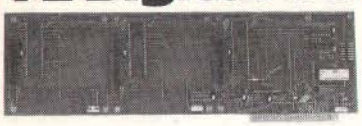
Fast Delivery

QUA TECH, INC.

478 E. Exchange St. Akron OH 44304
(216) 434-3154 TLX: 5101012726

Inquiry 245

72 Digital I/O



PXB-721
Parallel Expansion Board

- For IBM-PC & Compatibles
- 72 Digital I/O Lines
- Simple Programming
- Uses One Expansion Slot
- Fast Delivery

$195

QUA TECH, INC.

478 E. Exchange St. Akron OH 44304
(216) 434-3154 TLX: 5101012726

Inquiry 246

MODULAR DATA ACQUISITION



- For IBM & Compatibles
- Flexible and Inexpensive
- Money Back Guarantee
- Free Technical Support

Fast Delivery

QUA TECH, INC.

478 E. Exchange St. Akron OH 44304
(216) 434-3154 TLX: 5101012726

Inquiry 247

VAR's OEM's RESELLER's

Save 20 to 40%
Import Direct

818-889-1092

IBM-PC* Logic Boards

XT Std. 4.7 MHz 640k Motherboard	$68 32
SI 1.0 (Full IBM comp. w/BIOS-0k)	
XT Super Turbo 4.7-10 MHz	$105 92
SI 3.7 (V-20, w/BIOS-0k)	
Baby 286 Turbo 6-10 MHz AT	$313 86
SI 10.3 (fits Std. XT Box, w/BIOS-0k)	
Super Baby 286 6-12 MHz AT	$348 86
SI 13.5 (fits Std. XT Box, w/BIOS-0k)	

IBM-PC* Components
(Partial List)

80/132 M/G/P Herc. Compatible (80x25,132x25,132x44, & 720x350)	$67 23
Color/Graphics/Printer (640x200 RGB Std.)	$49 12
Multi Disk I/O (Floppy Ctrl, Par, Ser, Clk, Cld)	$57 23
Amber Monitor Hi Res (Tilt-swivel Base & Anti-glare Screen)	$66 12
RT/AT/XT Keyboard 5339 Style (Hi-quality with great feel)	$56 40
DS/DD Floppy Drive (Hi-quality w/Direct Drive motor)	$59 87
AT Mini Box w/Lock (Perfect chassis for Baby 286's)	$35 13
Baby AT Power Supply (180 Watts in a XT size)	$78 27
EGA Card w/Printer Port (Now affordable)	$168 43
Super Modem Card (300/1200/2400 Baud, Hayes Comp.)	$184 64
2 Meg EMS Memory Card (Full EMS Std. w/1 Meg RAM)	$200 87
20 Meg Hard Disk Drive (Half High, w/Ctrl)	$318 61
AT Portable Case Baby 286 (AT Key, 180 Watts, Amber TTL)	$497 22

ACS Imports specializes in buying custom and standard electronics components to fit your specific needs. We have years of expertise buying and importing components.

ACS Imports will solve your sourcing needs.

Call: 818-889-1092

ACS Imports

5311 Derry Ave. #A
Agoura Hills, CA 91301
TLX 510 601 8224
FAX 818 889 5605

*IBM is trademark International Business Machines
All prices are FOB Taiwan - Import Quantities

Inquiry 221

P.C. Computer Brokers Inc.

PCCB Has Super Values

Overnight Delivery Available. Call In Your Toll FREE Order Today 1-800-245-4122

LX-86
List $349.00
$229.95



FX-85
List $599.00
$339.95
FX-86E
CALL



FX-286
List $799.00
$499.95
FX-286E
$549.95



Call PCCB For SUPER VALUES

EX-800
List $799.00
$459.95



EX-1000
List $995.00
$599.95



Call In Your Toll Free Order Today 1-800-245-4122

CR420i
$679.95



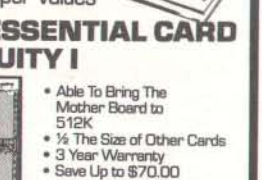
LQ-800
List $799.00
$499.95



LQ-1000
List $1095.00
$699.95

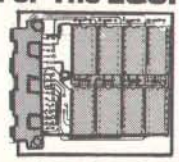


LQ-2500
List $1595.00
$1049.95



Call PCCB For Super Values

The Most ESSENTIAL CARD For The EQUITY I



- Able To Bring The Mother Board to 512K
- ½ The Size of Other Cards
- 3 Year Warranty
- Save Up to $70.00

$99.95

Call PCCB Today

Prices Subject to Change Without Notice

Add 2.9% for use of Visa, M/C, Choice & Discover. Add 5% for use of American Express. Restocking fee: 20% of mdse. cost.

These Prices Are Good For Mail Order Dept. Only

P.C. Computer Brokers Inc.
3879 East 120th Ave.
Thornton, CO 80233
(303)450-6727

1-800-245-4122

Inquiry 3



RS232C IBM PC Compatible
Paper Tape Transmitter/Model 612

Stops and starts on character at all speeds, uses manual control or X-on, X-off 90-260 volt, 50-60 Hz power. 50-9600 baud, up to 150 char/sec synchronous or asynchronous; gated internal or external clock, RS 232C, current loop or parallel output, reads 5-8 level tape, 7-11 frames per character, even or odd parity. Desk top or rack mount.

Addmaster Corporation, 2000 S. Myrtle Ave., Monrovia, CA 91016, (818) 358-2395, Telex 674770 Addmaster SGAB

Inquiry 122

FIND THE WIDEST RANGE OF DP WORKSTATIONS, ACCESSORIES & SUPPLIES IN THIS FREE GLOBAL GUIDE ...all at HUGE SAVINGS!



The GLOBAL GUIDE offers more variety than any office equipment, computer or software dealer; plus, toll-free order convenience. Use the Reader Service Number or dial **1-800-8-GLOBAL (That's 1-800-845-6225).**

GLOBAL
COMPUTER SUPPLIES
45 South Service Road, Plainview, NY 11803

Inquiry 58

DATAFLEX™

- Multi-user Database!
- Powerful!
- Multiple Operating System Compatibility!
- Attractive Dealer Pricing!
- Full Dealer Support!

Dataflex is a trademark of Data Access

Dealer Inquiries Invited

COGITATE

24000 Telegraph Road
Southfield, Michigan 48034 USA
(313) 352-2345

Inquiry 27

SAVE MONEY EPROM PROGRAMMER



APROTEK 1000 ONLY
$265.00
COMPLETE WITH PERSONALITY MODULE

117 AC POWER-RS-232 CONNECT
-6 BAUD RATES - HANDSHAKE TO HOST
ALLOWS READ, WRITE, VERIFY & COPY

Comes complete with IBM-PC, Apple, or CPM (Specify Computer) Driver Program on Disc.

Programs the following 5 Volt 24 or 28 pin devices: 2716 series through 27512, 25xx series, 68764 plus others. Please Specify Personality Module desired with order. Additional Personality Modules only $15.00 ea. **Full 1 year warranty.**

TO ORDER: CALL 1-800/962-5800 OR WRITE
APROTEK
1071-A AVENIDA ACASO
CAMARILLO, CA 93010
Info: (805) 987-2454

Add $4.00 Shipping-USA
VISA or MC Add 3%
We Accept Govt., School & Large Corp. P.O.s

Inquiry 49

NEW AN I/O™ Series Analog Interfaces for your PC/APPLE

Versatile Accurate and Fast



MODELS

AP-8	• 8-bit A/D and D/A to 50Khz, amplifier, anti-aliasing filters, etc.$299.
AP-12	• 12-bit A/D and D/A to 40Khz, analog multiplexer, amplifier, S/H, 8-bit I/O, clock, etc. $450.
PC-12	• 12-bit A/D or D/A to 60Khz, analog multiplexer, amplifier, anti-aliasing filter, S/H, on board VCO function generator, 8-bit I/O, etc. $750.
PC-DMA	• Our best available analog interface. 12-bit A/D or D/A to 100Khz, DMA driven to allow real-time processing,on board timer for zero timing jetter, input and output filters, amplifier, S/H, multiplexer 500Hz to 100Khz phase-locked (to timer) function generator, fully program mable. $1250.

PC-model designation refers to IBM PC compatible boards. AP for Apple II. Prices include software. Peripheral multi-channel input signal conditioner and filter, and PC-based FFT board available soon. For purchase or info please contact:

CANETICS, Inc. PO Box 70549, Pasadena, Ca 91107
Telephone (818) 584-0438

Inquiry 127

UNDERSTAND

Feeds and refolds paper in the same space you use for your printer! Swing paper receiving tray down and bottom shelf becomes a storage for paper. Only **$44.95.**



Other stands and trays available from **$19.95.**

CALL TOLL FREE

1-800-344-6934

VISA MasterCard

Grand Union
Micro Systems
2222 Gumtree Lane, Fallbrook, CA 92028
For Customer Service Call (619) 723-0882



Programmer's Paradise Gives You Superb Selection, Personal Service and Unbeatable Prices!

Welcome to Paradise. The MS/PC-DOS and XENIX software source that caters to your programming needs.

Discover the Many Advantages of Paradise...

- Lowest price guaranteed
- Latest versions
- Huge inventory, immediate shipment
- Knowledgeable sales staff
- Special orders
- 30-day money-back guarantee

We'll Match Any Nationally Advertised Price.

	LIST	OURS
C++		
ADVANTAGE C++	$ 495	469
PFORCE++	395	CALL
C COMPILERS		
C-86 PLUS	497	445
DATALIGHT – C	60	49
DATALIGHT – C DEVELOPER'S KIT	99	79
LATTICE C 3.2	500	269
LATTIC C W/SOURCE	900	545
LET'S C	75	59
W/CSD DEBUGGER	150	109
MICROSOFT C 4.0	450	275
MARK WILLIAMS C	495	289
SUPERSOFT C	395	339
WIZARD C	450	369
C INTERPRETERS		
C-TERP	300	235
INSTANT C	500	379
INTRODUCING C	125	105
RUN/C	150	89
RUN/C PROFESSIONAL 1.1	250	169
ASSEMBLERS, LINKERS		
386iASM/LINK	495	445
ADVANTAGE LINK	395	349
MACRO-86	150	98
PASM-86	195	125
PLINK 86 PLUS	495	325
QUELO 68000 X-ASM	595	509

Lattice Specials

C COMPILER	500	269
C CROSS REFERENCE GENERATOR	50	35
C FOOD SMORGASBORD	150	95
C-SPRITE	175	125
CURSES	125	85
DBC-III	250	175
LMK	195	135
RPG II COMPILER	750	635
RPG COMBINATION PACK	1100	939
SECRET DISK	120	85
SIDETALK	120	85
TEXT MANAGEMENT UTILITIES	120	85

GRAPHICS		
ADVANTAGE GRAPHICS	295	225
ESSENTIAL GRAPHICS	250	195
GRAPHIC	350	289
GSS GRAPHICS DEVELOPMENT TOOLKIT	495	379
GSS KERNEL SYSTEM	495	379
GSS METAFILE INTERPRETER	295	239
GSS PLOTTING SYSTEM	495	379
HALO—ONE LANGUAGE	300	209
W/TEN FONT PACK	425	297
HALO—FIVE MICROSOFT LANGUAGES	595	415
METAWINDOWS	185	115
METAWINDOWS PLUS	235	189
METAFONTS	80	59
METAFONTS PLUS	235	189

	LIST	OURS
C UTILITY LIBRARIES		
ASYNC MANAGER	175	135
BASIC C	175	129
C ESSENTIALS	100	85
C FOOD SMORGASBORD	150	95
W/SOURCE	300	188
C TOOLS PLUS	175	135
ESSENTIAL C UTILITY LIBRARY	185	135
ESSENTIAL COMMUNICATIONS	185	135
W/BREAKOUT DEBUGGER	250	195
GREENLEAF FUNCTIONS	185	135
GREENLEAF COMM	185	135
THE HAMMER	195	175
MULTI C	149	135
MULTI COMM	149	135
PFORCE	395	245
TIMESLICER	295	265
W/LIBRARY SOURCE	1000	CALL
TOPVIEW TOOLBASKET	250	189
SCREEN DISPLAY, WINDOWS FOR C		
C WORTHY	295	269
CURSES	125	85
W/SOURCE	250	184
GREENLEAF DATA WINDOWS	225	179
W/SOURCE	395	339
FLASH UP WINDOWS	75	68
MICROSOFT WINDOWS DEVELOPMENT SYSTEM	500	319
ON-LINE HELP	149	109
PANEL	295	219
POLYWINDOWS	CALL	CALL
SCREENPLAY (LATTICE)	150	135
SOFTSCREEN HELP	195	175
VIEW MANAGER	275	199
VITAMIN C 3.0	225	199
VC SCREEN	99	84
WINDOWS FOR C	195	145
WINDOWS FOR DATA	295	239
Z VIEW	245	189
FILE MANAGEMENT		
BTRIEVE	245	195
XTRIEVE	245	195
W/REPORT GENERATION	390	315
BTRIEVE/N	595	465
XTRIEVE/N	595	465
W/REPORT GENERATION	940	750
C TREE	395	329
R TREE	295	249
C TREE/R TREE BUNDLE	650	529
CQL	395	329
DBC III	250	175
W/SOURCE	500	379
DBC III PLUS	750	599
DB VISTA	195	155
W/SOURCE	495	425
DB QUERY	195	155
W/SOURCE	495	425
FABS	150	129
FABS PLUS	195	169
INFORMIX	795	639
INFORMIX 4GL	995	799
INFORMIX SQL	795	639
PHACT	295	265

	LIST	OURS
MAKE, LINT, PROFILE, UTILITIES		
C CROSS REFERENCE GENERATOR	50	35
LMK	195	135
POLYMAKE	99	78
OTHER POLYTRON	CALL	CALL
PMAKER	125	89
PFINISH	395	235
THE PROFILER	125	94
PC LINT	139	105
PRE-C	295	159
TEXT MANAGEMENT UTILITIES	120	85
DEBUGGERS		
ADVANCED TRACE 86	175	129
BREAKOUT	125	99
CODESMITH 86	145	105
C SPRITE	175	125
CSD SOURCE DEBUGGER	75	59
PERISCOPE I 3.0	345	293
PERISCOPE II 3.0	175	145
PERISCOPE II-X 3.0	145	109
PFIX 86 PLUS	395	235
XVIEW 86	60	49

March BUNDLE of the Month

RUN/C Pro- Best-selling C interpreter PLUS Greenleaf Functions or C Utility Library. Convenience disk included—One command loads library!

LIST TOGETHER $435 **OURS** $289

EDITORS		
BRIEF	195	CALL
CVUE	75	59
W/SOURCE	250	195
EDIX	195	155
EMACS	295	265
EPSILON	195	159
FIRSTIME (C)	295	229
KEDIT	125	105
LSE	125	89
PMATE	195	119
PC/VI	149	129
SPF/PC	195	149
VEDIT	150	109
VEDIT PLUS	185	139
ADDITIONAL PRODUCTS		
DAN BRICKLIN'S DEMO PROGRAM	75	59
FASTBACK	175	149
INTERACTIVE EASYFLOW	150	129
PDISK	195	129
SOURCE PRINT	97	87
TREE DIAGRAMMER	77	69
VENTURA PUBLISHER (XEROX)	895	805
PASCAL COMPILERS		
MICROSOFT PASCAL	300	189
PASCAL 2	350	329
TURBO PASCAL	100	69
OTHER BORLAND	CALL	CALL

	LIST	OURS
TOOLS FOR TURBO PASCAL		
ALICE	95	68
FIRSTIME	75	59
FLASH UP WINDOWS	90	79
TURBO HALO	129	99
SCREENPLAY	100	89
SCREEN SCULPTOR	125	94
T-DEBUG PLUS	60	50
TURBO EXTENDER	85	65
TURBO PASCAL ASYNC MGR	100	84
TURBO PROFESSIONAL	70	49
TURBO POWER TOOLS PLUS	100	83
TURBO WINDOWS	80	65
OTHER TURBO TOOLS	CALL	CALL

NEW Products

ADVANTAGE C++ for XENIX—Take advantage of object-oriented programming methods. Add resiliency and flexibility to your code. Build large and sophisticated programs more productively.
List $695 Ours **$660**

ADVANTAGE Make—Feature-packed MS/PC-DOS version of UNIX MAKE utility.
List $125 Ours **$99**

SSP/PC—Fast, extremely accurate library of over 145 math subroutines. Callable from C, FORTRAN, Pascal, BASIC.
List $350 Ours **CALL**

TIMESLICER—New Microsoft version. Multitasking, linkable library supporting concurrent tasks and real-time event processing with header files provided for C++, C and assembly. Library source available!
List $295 Ours **$265**

VENTURA PUBLISHER (XEROX)—Desktop publishing software, lightning fast, loaded with features. Create professional-looking documentation at minimal cost!
List $895 Ours **$805**

BASIC		
BETTERBASIC	199	139
SUMMIT ADD ONS	CALL	CALL
BETTER TOOLS	95	89
FINALLY	99	89
MICROSOFT QUICKBASIC	99	75
PROFESSIONAL BASIC	99	75
8087 MATH SUPPORT	50	45
PANEL-BASIC	145	115
TRUE BASIC	150	105
ADD ONS	CALL	CALL
COBOL COMPILERS/UTILITIES		
MICROSOFT COBOL	700	445
MICROSOFT COBOL TOOLS	350	205
MICROSOFT SORT	195	139
MICRO/SPF	175	CALL
OPT-TECH SORT	149	115
REALIA COBOL	995	785
SCREENPLAY	175	155
RM/COBOL	950	639
RM/COBOL 8X	1250	895
VISUAL COBOL (MBP)	1150	1015
FORTRAN COMPILERS/UTILITIES		
LAHEY FORTRAN	477	CALL
MICROSOFT FORTRAN	350	209
RM/FORTRAN	595	389
ACS TIMES SERIES	495	419
87 SFL	250	225
FOR-WINDS	90	78
FORLIB-PLUS	70	54
GRAFMATICS OR PLOTMATICS	135	119
GRAFMATICS AND PLOTMATICS	240	219
FORTRAN SCIENTIFIC SUBROUTINES	295	249
STRINGS AND THINGS	70	54

XENIX/UNIX SOFTWARE

XENIX SYSTEM V (COMPLETE SYSTEM)—SCO	1295	995
SYSTEM V/AT—MICROPORT	440	395
OTHER SCO AND MICROPORT	CALL	CALL
ADVANTAGE C++	695	660
BTRIEVE	595	465
C-ISAM	319	285
C TREE	395	329
MICROSOFT BASIC	350	239
MICROSOFT COBOL	995	635
MICROSOFT COBOL TOOLS	450	205
MICROSOFT FORTRAN	695	439
MICROSOFT PASCAL	695	439
PANEL	625	545
RM/COBOL	1250	949
RM/FORTRAN	750	549

ADDITIONAL LANGUAGES		
APL PLUS	595	429
JANUS ADA/C PACK	95	89
LOGITECH MODULA 2	89	63
PC/FORTH	150	119
SMALLTALK V	99	88
TURBO PROLOG	100	75

CALL FOR OTHERS/ADD-ONS!

Terms and Policies

- **We honor MC, VISA, AMERICAN EXPRESS**

No surcharge on credit card or C.O.D. Prepayment by check. New York State residents add applicable sales tax. Shipping and handling $3.00 per item, sent UPS ground. Rush service available, prevailing rates.

- Programmer's Paradise will match any current nationally advertised price for the products listed in this ad.
- **Mention this ad when ordering**—some items are specially priced.
- Prices and Policies subject to change without notice.
- Corporate and Dealer inquiries welcome.

1-800-445-7899 In NY: 914-332-4548

Programmer's Paradise
42 River Street, Tarrytown, NY 10591
914-332-4548

Programmer's Paradise



Inquiry 165

Inquiry 45

BYTE CONNECTION INC.

BOTTOM LINE PRICE BUSTERS!

★ ★ ★ PERSONAL COMPUTERS ★ ★ ★

IBM XT (Enhanced), w/256K, 1 Fl., K.B.	$1195
IBM AT, 256K, 1.2 Floppy, K.B.	$2495
IBM AT #339, 1.2 Floppy, IBM 30 MB, K.B.	$4295
COMPAQ DESK PRO 286, w/256K, 1.2 Fl., K.B.	$1999
COMPAQ DESK PRO 386, w/1.2 Fl., 40 MB	$4995
SPERRY IT, w/640K, 1.2 Floppy, 40 MB, K.B., 80287, DOS	$2995
TOSHIBA PORTABLE 1100 PLUS	$1750
UBM AT, w/640K, 1.2 Floppy, K.B.	$1395

★ ★ ★ PLOTTERS ★ ★ ★

CALCOMP 1043 (A - E)	$7195
CALCOMP 1044 (A-E, Roll)	$10997
HI DMP 56A (A - E)	$4495
HI DMP 51/52 (C - D)	$3575
HI DMP 41/42 (C - D)	$2549
HI PC 695 (A - B, 4 Pen)	$ 650
HP Color Pro 7440 (A, 8)	$ 995
HP 7475 (A - B, 6 Pen)	$1549
HP Draft Pro 7570 (C - D, 8 Pen)	$4475
HP 7580B (A - D, 8 Pen)	$8395
IO LINE LP3700 (A - E)	$3195
IO LINE LP4000 (A - E)	$4295

★ ★ ★ DIGITIZERS ★ ★ ★

CALCOMP 12 x 12	$ 709
CALCOMP 44 x 60	$5099
GTCO 12x12	$ 525
GTCO 24x36	$2450
HITACHI 15 x 15	$1425
KURTA 12 x 12	$ 580
KURTA 12 x 17	$ 675
SUMMAGRAPHICS 12 x 12	$ 449
SUMMAGRAPHICS 12 x 17	$ 735

★ ★ GRAPHIC CONTROLLERS & MONITORS ★ ★

NEC JC - 1401 & GB - 1, (640 x 480)	$1075
MITSUBISHI 6922PLPK & ARTIST I, (1024 x 768I)	$3195
MITSUBISHI 9920 & VERTICOM H-16, (1024 x 768N)	$4999
Samsung EGA, Monitor Vega EGA	$ 720
BNW 151 (1024 x 1024I)	$1245
VMI 8825 (1024 x 800N)	$2149
Artist 10 (1024 x 768N)	$2275

SPECIAL OF THE MONTH
AST PREMIUM PUBLISHER SYSTEM
w/40 MB HD, Monitor, Turbo Scanner, Laser Printer & Ventura S/W. $8595

★ ★ ★ SOFTWARE ★ ★ ★

AUTOCAD 2.52	$2195
COMPUTER ASSOCIATE (IVS) - A/R, A/P, G/L,I/G	EACH $ 385
CYMA Medical	$1625

★ ★ ★ PRINTERS ★ ★ ★

HEWLETT-PACKARD LASER JET	$2250
★ HP Plus	$2995
BLAZER LASER PRINTER	$1995
CANON LASER PRINTER	$2050
CITIZEN 35	$ 515
FUJITSU 2200	$ 479
NEC P6	$ 479
OKIDATA 193+	$ 530
TOSHIBA P341	$ 699

★ ★ HARD DRIVES & BACK UP SYSTEMS ★ ★

MINISCRIBE 6053, 44 MB	$ 695
HARD CARD Plus	$ 675
SEAGATE 4096, 96 MB	$1395
TAPE B/U	$ 795

CALL FOR WHAT IS NOT LISTED,
WE GUARANTEE THAT YOUR CALL WILL NOT BE A WASTE. LEASING AVAILABLE.

No charges for testing and configuring equipment. Prices and availability subject to change without notice.

(714) 778-6496
167 West Cerritos Ave.
Anaheim, CA 92805
Open 8 - 5 PST

Inquiry 26

DESK-ADAPTOR™
CONVERT YOUR DESK TO A COMPUTER WORK STATION



Why buy expensive computer furniture for home or office?

- Convert any desk or table into a computer work station.
- The Desk-Adaptor™ keyboard holder lowers keyboard height to optimum keying height for maximum comfort and productivity.
- Installed and removed in seconds without tools. Easily stored when not in use.
- Padded clamps won't mar desk or table surfaces.
- Accommodates all keyboards up to 9.5 inches deep.

$27 plus $3 shipping. MN residents add 6% sales tax.

Appro-Tech, Inc.
4201 Brookside Avenue
St. Louis Park, MN 55416

Inquiry 139



UNIVERSAL EPROM PROGRAMMER $599!!

- Built in timer erase optn; foam pad area
- Menu selection; No modules or adapters
- User friendly softw; Complete help menu
- Direct tech. support; Full 1 yr. warranty
- Stand alone duplication & verify;
- Quick pulse algorithm: 27256 under 60 sec
- All 24/28 pins to 27011 & CMOS E(E)PROMS
- Micros: 8741, 2, 4, 8, 9, 51, 52, 55, 9761 & CMOS
- Auto baud RS232 to 19.2k; Free PC drivers
- Ofset/split Hex, Binary, Intel & Motorola 8, 16 & 32 bit files: Kits from $99!

B&C Microsystems
6322 Mojave Dr., San Jose, CA 95120
Ph (408) 997-7685 Tx 4995363 Visa & MC

Inquiry 93

IBM PC/VT220

EM220 $169

- *VT220, VT102 emulation*
- *File Transfer*
- *132 Column modes*
- *Color Support*
- *Hot Key*

TEK 4010/4014

EM4010 $249

- *Tektronix 4010 emulation*
- *VT220, VT102 emulation*
- *Picture files*
- *High resolution hardcopy*
- *Supports IBM, IBM Enhanced, Hercules, Tecmar and AT&T.*

DCS
3775 Iris Ave., Suite 1B
Boulder, CO 80301
(303) 447-9251

Trademarks: VT100 — Digital Equipment; IBM PC, XT — IBM Corp.

Inquiry 141

DYNAMIC RAMS

1Mbit	100ns	$38.00
41256	100ns	$ 3.60
41256	120ns	$ 2.60
✓41256	150ns	$ 2.20
4464	150ns	$ 3.25
✓4164	150ns	$ 1.00

PROCESSORS		
8087-2	8mHz	$149.00
8087	5mHz	$109.00
80287-5	6mHz	$169.00
80287-8	8mHz	$265.00
V-20	8mHz	$ 12.75
V-30	8mHz	$ 14.00
STATIC RAMS		
6264LP-15	150ns	$ 2.95

E PROMS		
27512	250ns	$18.50
27C256	250ns	$ 5.50
27256	250ns	$ 4.95
27128	250ns	$ 3.75
27C64	200ns	$ 4.50
2764	250ns	$ 3.25
2732A	250ns	$ 4.25
8000's (Parts in stock)		

I.C. EXPRESS
15358 Valley Blvd., City of Industry, CA 91746
Phone: 818-369-2688 (Mon-Fri • 8-5)
ORDER TOLL FREE
(800) 892-8889 • (800) 882-8181
Outside California Inside California
CALL FOR CURRENT PRICES & VOLUME DISCOUNTS.
Price Shown for Cash • MasterCard/VISA add 3% more.
Prices are subject to change. Minimum order $10.00.
California residents must add 6.5% sales tax.
Shipping & Handling: UPS Ground $5.00, UPS Air $7.00 (under 1 lb.)
ALL MERCHANDISE IS 100% GUARANTEED.

Inquiry 250

9-TRACK MAG. TAPE SUBSYSTEM FOR THE IBM PC/XT/AT AND...



For information interchange, backup and archival storage, IBEX offers a 9-track, IBM format-compatible ½" magnetic tape subsystem for the IBM PC, featuring:

- **IBM format 1600/3200 and 800 cpi.**
- **Software for PC-DOS, MS-DOS.**
- **Also for DEC, VAX, VME, S-100, RS-232, IEEE 488.**

IBEX
IBEX COMPUTER CORP.
20741 Marilla St.
Chatsworth, CA 91311
(818) 709-8100
TWX: 910-493-2071

Write, phone or TWX for information.

Quelo® 68000 Software Development Tools

Quelo Assembler Packages are **Motorola compatible.** Each package includes a macro assembler, linker/locator, object librarian, utilities for producing **ROMable code,** extensive indexed typeset manuals and produces **S-records,** Intel hex, **extended TEK hex, UNIX COFF** and symbol cross references. **Portable source** written in "C" is available. It has been ported to a variety of mainframes and minis including **VAX.**

68020 Assembler Package
For CP/M-86, -68K and MS/PC-DOS ..... $ 750

68000/68010 Assembler Package
For CP/M-80, -86, -68K and MS/PC-DOS ..... $ 595

68000 "C" Cross Compiler
For MS/PC-DOS by Lattice, Inc.
With Quelo 68000/68010 Assembler Package $1095
With Quelo 68020 Assembler Package $1250

Call **Patrick Adams** today:
Quelo, Inc.
2464 33rd W. Suite #173
Seattle, WA USA 98199
Phone 206/285-2528
Telex 910-333-8171

COD, Visa, MasterCard

Trademarks: CP/M, Digital Research; MS, Microsoft Corporation; Quelo, Quelo, Inc.

ATTAK-286™ MODEL 1A

HIGH SPEED 12 MHZ OPERATION SELECTABLE TO 6,8,10, and 12 MHZ!

- *FULL IBM PC-AT* COMPATIBILITY!*
- *FULL MEGA-BYTE RAM CAPACITY!*

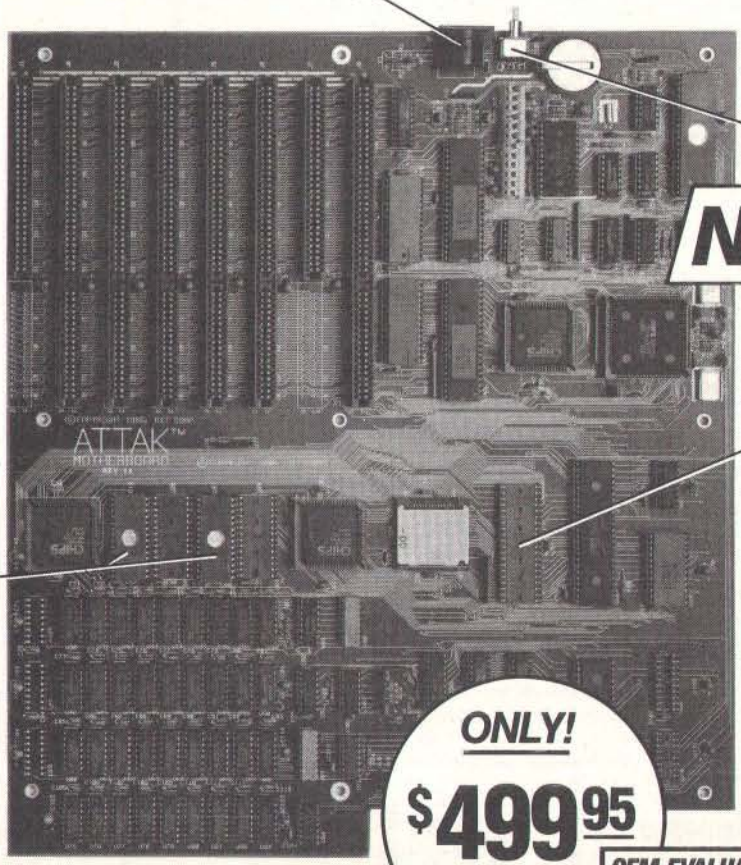
THOUSANDS SOLD WORLDWIDE!

100% DESIGNED, MANUFACTURED, ASSEMBLED AND TESTED IN USA!

AIT Corporation is a publicly traded company. Majority USA owned and traded on the OTC market under AITC



Keyboard Interface same as PC-AT



FULL TIME PRODUCT SUPPORT AND SERVICE.

UNIQUE FEATURE!
Hardware Reset Switch

NEW!

0-1 WAIT STATES!

VOLUME DISCOUNTS AVAILABLE!

UNIQUE FEATURE!
Multi-Speed 80287 Numeric Processor Speed-Up Capability (Switch Selectable)

UNIQUE FEATURE!
Complete Set-Up Software in ROM BIOS (No Disk Required for Set-Up)

Triple Tested for 100% Quality Assurance!

Highest Quality Industrial Grade AMP Sockets!

Complete Documentation Package with Full Schematic Diagrams Included

ONLY!

$499.95

OEM EVALUATION BOARD
Completely Assembled and Tested with all IC's and Components

☐ ATTAK-286™ MODEL II 24MHZ	CALL
☐ ATTAK-386™ 32 BIT MICRO	CALL
☐ CASES, POWER SUPPLIES, PERIPHERALS, ETC.	CALL
☐ TURBO-SCOPE™ A/D BOARD	$99.95
☐ ATTAK-286™ MODEL 1A BARE BOARD	$99.95

- **OK RAM**
- **8 MHZ Version, Expansion to 12 MHZ**

100% SATISFACTION GUARANTEED.
10 DAY MONEY BACK GUARANTEE IF NOT COMPLETELY SATISFIED!

AMERICAN EXPRESS · VISA · mastercharge · EURO CARD

ORDER NOW!
SAME DAY SHIPMENT!
(FOR IN STOCK ITEMS)

AiT™ CORPORATION
ADVANCED INTELLIGENCE TECHNOLOGY

4100 Spring Valley Road
Suite 400
Dallas, Texas 75244
(214) 490-0344
TELEX 821379
FAX (214) 960-1309

TERMS: We accept cash, checks, money orders and credit cards. Prices and availability subject to change without notice. Shipping and handling charges via UPS ground 50¢/lb UPS air $1.00/lb. Minimum charge $3.00.

*IBM and IBM PC-AT are trademarks of International Business Machines

© 1986 AIT CORP.

Best Prices Best Service

HARDWARE

COMPUTERS

PANASONIC Business & Executive Partners . . . CALL
ATARI ST COMPUTERS . . . . . CALL

MODEMS, BOARDS, DRIVES

Evercom 1200 Internal	119	SixPakPlus 384K	209
Hayes Modems	CALL	SixPak Premium	249
Practical Modem 1200	135	Intel Above Board PC	225
Genoa Spectrum	185	Above Board AT	355
Hercules Graphics +	189	Talltree J-Ram 3	189
Auto Switch EGA	389	J-Ram 3AT	249
EGA Wonder	255	J-Laser +	439
Tecmar EGA Master	279	Microsoft Mach 10	265
Video 7 Vega Deluxe	379	Seagate 20MB Kit	385
384K RAM Card	85	Seagate 30MB Kit	449
Captain 384K	159	Filecard 20MB	569
Advantage Premium	439	Filecard 30MB	679
Rampage/EGA AT	759	Hardcard 20MB	679

OTHER HARDWARE

EPSON-All Models LX/FX/EX/LQ	BEST PRICES	Sweet P600	749
		Roland DXY-880 Plotter	899
Citizen 120D	189	Houston Inst DMP-29	1799
Panasonic 1080 I	219	Amdek 722	509
Panasonic 1091 I	285	NEC 1401 Multi-Sync	639
Panasonic 1092	329	Sony KV1311 RGB/TV	CALL
Panasonic P3131	269	Sony 1302 Multi-Sync	CALL
Summasketch 1201	379	Samsung TTL	89

SOFTWARE

WORD PROCESSING

Manuscript	339
Microsoft Word 3	249
Word Perfect 4.1	209
PFS: First Choice	89
PFS: Pro Write	115
Reference Set	53

ACCOUNTING

BPI Enterprise/Mod	429
Complete Bus. Actng	159
DAC EZ Accounting	42
Open Systems V3/Mod	429
Real World	CALL
Tax Preparer	195

DATABASE

dBase III Plus	399
Rapid File	259
Paradox	449
Powerbase	199
R Base System V	349
Reflex	83
Revelation	529
PFS: Pro File	145
Q & A	239

SPREADSHEETS

Lotus/Symphony	CALL
HAL	103
Framework II	399
Open Access II	289
Ability	61
Mosaic Twin	57
PFS: Pro Plan	145

GRAPHICS

Click Art Pers. Publisher	109
Harvard Pro Publisher	399
First Impression	389
Chartmaster	219
Fontasy	43
Freelance Plus	339
Harvard Pres. Graphics	229
Generic Cad	69
In*A*Vision	255
Newsroom Pro	79
Printmaster Plus	36
ProDesign II	169
Show Partner	48
Dr. Halo II w/Mouse	109

UTILITIES

Alice Pascal	59
Microsoft C	269
Quick Basic	60
Turbo Pascal Ver 3	59
Turbo Prolog	59
Desqview	59
Windows	59
Carbon Copy	117
Fastback	95
Norton Utilities	55
Pop-Up Deskset	43
HOT	45
Disk Optimizer	32
SQZ	56
Xtree	31
Statgraphics	449
Total Project Manager	289

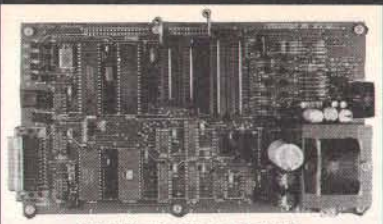
800-662-2686 orders only
for Ca. Orders, Tech Support, **415-668-9350**
Call or Write for Free Catalog

PAYMENT: (No Fee For Credit Cards.) Visa, MasterCard, Cashier's Checks, Personal Checks with 2 week hold. Qualified P.O.'s. California residents add sales tax.
SHIPPING: UPS ground-2% per order, $5 min. FREE for SW orders over $1000. UPS Blue-3% per order, $7 min. FREE for SW orders over $1500. Printers, Monitors, Disk Drives, Computers — Call for charges.

All Products New with full warranties.
Price & availability subject to change without notice.

THE BAY Express COMPANY

584 CASTRO ST., SUITE 487 SAN FRANCISCO, CA 94114
a division of MCSS, Inc. Computer & Software specialists since 1981



UNIVERSAL EPROM PROGRAMMER KIT $99!!

* On board power supply, 110/220 VAC;
* Menu selection; No personality modules;
* Built in monitor for easy I/O debugging;
* User friendly softw; Full tech. support
* Detailed 50 page manual with schematics;
* Quick pulse algorithm: 27256 under 60 sec
* All 24/28 pins to 27011 & CMOS E(E)PROMS
* Micros: 8741, 2, 4, 8, 9, 51, 52, 55, 9761 & CMOS
* Auto baud RS232 to 19.2k; Free PC drivers
* Ofset/split Hex, Binary, Intel & Motorola 8, 16 & 32 bit files; Cased 1409C-34 599!

B&C Microsystems
6322 Mojave Dr., San Jose, CA 95120
* Ph (408) 997-7685 Tx 4995363 Visa & MC

Modula-2

IBM PC/DOS
Native Code Compiler

Full implementation: "make" utility, compiler, native code generator, and assembler level interface. Complete runtime source is included. Comprehensive manual.

MC and Visa Accepted

$89.95

farbware
1329 Gregory
Wilmette, IL 60091
(312) 251-5310

Inquiry 108

Get the whole story on graphics terminal emulation.



To find out more about software that lets your PC emulate TEKTRONIX™ 4105/6/7/9 and DEC VT100™ terminals, call or write:

GRAFPOINT
4340 Stevens Creeks Blvd., Suite 280, San Jose, CA 95129 (408) 249-7951

Inquiry 126

DATA ACQUISITION TO GO
INTERFACE FOR ANY COMPUTER
FREE IBM SOFTWARE

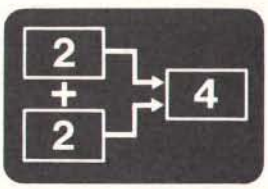


Connects via RS-232. Fully IBM compatible. Built-in BASIC. Stand alone capability. Expandable. Battery Option. Basic system: 16 ch. 12 bit A/D, 2 ch. D/A, 32 bit Digital I/O. Expansion boards available. Direct Bus units for many computers.

(201) 299-1615
P.O. Box 246, Morris Plains, NJ 07950

ELEXOR

Inquiry 101



PICTURES THAT THINK

Boxes & Arrows™ is an IBM PC-based block diagram editor and computing system. If you are looking for something more than a spreadsheet, Boxes & Arrows will let you combine computation with pictorial representation.

- **Automatic box & line drawing**
- **Labels and algebraic formulas**
- **Any printer, any display**
- **No limit to diagram size**
- **Call or write for full details**

inner loop software

Inner Loop Software
5456 McConnell Avenue
Los Angeles, CA 90066
(213) 822-2800

Inquiry 143

TIME SAVING — MONEY SAVING
PRINTER BUFFER



Printer Speeder

Works with any computer connected to a Parallel Printer ■ All models user expandable to 512K ■ Complete. Includes cable and power supply.

PRINTER SPEEDER is a parallel printer buffer which works with any parallel printer and frees up your computer for productive use while printing. Very high capacity (up to 512K) and full time space and null character compression means that *PRINTER SPEEDER* is ready to take on the really big jobs. A special Pause-on-Formfeed feature allows printing single sheets from the buffer. *PRINTER SPEEDER* also has Copy, Clear, and Self-Test functions built in. Supplied complete with a 5' printer cable and UL listed power supply, *PRINTER SPEEDER* is easy to install and use. All models are user expandable to 512K at any time by just plugging in standard 256K RAM chips. *PRINTER SPEEDER* is the professional's choice, for size, features, and price.

PRICES: 128K - $299. 256K - $329. 512K - $389.

Available from dealers or direct from us. We accept M/C, VISA, AMEX or COD orders. No charge for shipping or COD. 30 day trial period (no-hassle refund policy) on all products. CA residents — 6% tax.

DEALER INQUIRIES INVITED.
O.E.M.s — We can modify our buffers to meet your special requirements.

jvb
1601 Fulton Avenue
Sacramento, CA 95825 ■ (916) 483-0709

The Specialists with the track record in Printer Buffers

Inquiry 157

PC COMPATIBLE



CAT™ 640
BASE SYSTEM
- 256K (Optional 640K)
- 150 watt pwr. supply
- AT Style Keyboard
- 4.77 or 8MHz Clock Speed
- 24 Hr Burn In

$427.00

The CAT™ 640 is compatible with all software written for the IBM™ PC. It also runs your software twice as fast as the IBM™ PC. It runs at 8 megahertz clock rate. More power for expansion. The 150 w. power supply has 8 expansion slots. The keyboard is an 'AT' style standard. The motherboard is 640K, 4 layers.

OPTION A	OPTION B	OPTION C
Base System plus: Monochrome Graphics Card Monochrome Graphics Monitor Parallel Port w/cable	Base System plus: Color Graphics Card Color RGB Monitor Parallel Port w/cable	Base System plus: Mono. Graph. Card Monochrome Graphics Monitor Parallel Port w/cable 20 Meg Hard Drive
$586.00	**$785.00**	**$986.00**

AT COMPATIBLE



CAT™ 286
BASE SYSTEM
- 1.2 megabyte Floppy
- 512K Ram (1024K Optional)
- 200 watt Pwr. Supply
- AT Style Keyboard
- 10MHz Clock Speed.

$1099.00

THE CAT™ 286 is a 'AT' compatible system, running all software written for the IBM™ AT. The CAT™286 runs at an impressive but not expensive 10MHz.

OPTION A	OPTION B	OPTION C
Base System plus: Mono. Graph. Card Monochrome Graphics Monitor Parallel Port w/cable	Base System plus: Color Graphics Card Color Graphics Monitor Parallel Port w/cable	Base System plus: EGA Interface Card EGA Hi Res Monitor Parallel Port w/cable
20Meg **1689.00** 40Meg **1989.00**	20Meg **1916.00** 40Meg **2216.00**	20Meg **2217.00** 40Meg **2517.00**

PRINTERS

EPSON

FX286	$499.00
FX85	389.00

Call for New Epson pricing

OKIDATA

ML192/193	379.00/549.00
ML292/293	559.00/669.00

TOSHIBA

P321	479.00
P341E	778.00
P351	Call

MODEMS

Hayes

1200B Internal	348.00
1200B External	388.00
2400B Internal	588.00
2400B External	628.00

BEST

1200B Internal Hayes Compat	124.00

TAPE BACK UPS

IRWIN

10 Meg Tape Bu w/software 1 casette	299.00
20 Meg	419.00

MONITORS



AMDEK

NEW

410 Amber/Green/White	189.00

Call 1-800-654-7762 for more AMDEK

MITSUBISHI ELECTRONICS

XC 1410C EGA	409.00

NEC

Multisync EGA	599.00

PGS Princeton Graphic Systems

PGS HX12E (RGB)	526.00
PGS MAX12E (Amber)	159.00

SAMSUNG

12'' Mono-Green	79.00
12'' Mono-Amber	89.00
12'' Flat w/tilt stand	94.00

TATUNG

EGA Monitor w/EGA Card	589.00

TAXAN

740 720X400 EGA	Call
760 EGA Monitor w/Paradise Autoswitch	719.00

DISK DRIVES



Tandon

TM100-2 360K	89.00
TM100-2 Logo	109.00

TEAC/FUJITSU/QUME

360K ½ Ht	87.00
1.2 Meg ½ Ht	119.00

HARD DRIVES

Seagate

ST225 20 Meg w/cont	369.00
ST238 30 Meg	349.00

MINISCRIBE

42MB (28MS)	594.00
70MB (28MS)	994.00

CMI/ATASI/MICROSCIENCE

10 Meg w/cont	239.00
20 Meg w/cont	339.00
30 Meg	449.00
40 Meg for AT	519.00

MEMORY—GRAPHICS MULTIFUNCTION BOARDS

AST RESEARCH INC.

Sixpac + w/384K	181.00
Sixpac Premium 256K	299.00

HERCULES

Mono Graphics Plus	195.00
Color Graphics	154.00

intel

8087-3, 5 MHz	109.00
8087-2, 8 MHz	154.00
80287-3, 5 MHz	169.00
80287-6, 6 MHz	175.00
80287-8, 8 MHz	249.00
80287-10, 10 MHz	339.00

DIAMOND

EGA Card 640X350 256K w/para port	209.00
Color Graphics	78.00
Mono Graphics	78.00
Io Card par,ser,clock,game	78.00
FDC w/cables	38.00
Hard disc Cont. w/cable	109.00

MEMORY UPGRADES

64K	
64K 150ns (set of 9)	8.00
256K	
256K 150ns (set of 9)	25.00
256K 120ns (set of 9)	39.00

MEAD COMPUTER CORP.

1000 Nevada Hwy., Unit 101
Boulder City, NV 89005

Terms:
C.O.D.'s Purchase Orders,
Cashier's Checks
Money Orders, Personal Checks

Call Now for LOWEST PRICES

(800) 654-7762

(702) 294-0204

Shipping:
UPS, Federal Express,
Call for shipping prices,
or we will ship C.O.D.

ALL TRADEMARKS ARE REGISTERED WITH THEIR RESPECTIVE COMPANIES

DISK-KING®

Receive 25% FREE Goods!

3M BASF

WHY RISK THE UNKNOWN...when you can get premium quality disks from the Leader and Inventor of magnetic media....**for less!!**

★100% tested & certified at 65% or higher clipping level★

★ 10 mil sturdy jacket ★ LIFETIME WARRANTY ★

5.25"	Reg. Price	100 + Net Price*
SS-DD-RH 48 TPI	.44	.35
DS-DD-48 TPI	.48	.38
DS-DD-RH 48 TPI*	.65	.52
DS-HD-96 TPI for the AT	1.35	1.08
3.5" SS-135 TPI	1.35	1.08
3.5" DS-135 TPI	1.50	1.20

Factory sealed in lots of 25. All 5.25" diskettes are supplied with Tyvek® sleeves, user ID labels, w/p tabs and reinforced hub rings. *Net price reflects 25% FREE goods.

FREE! CX-60 Cassette

& $2.00 Rebate inside!



SS-DD-RH		DS-DD-RH
.73*	5.25"/48 TPI-10/bx.	.89
1.19	3.50"/135 TPI-10/bx.	1.79
DS-HD-96 TPI for the "AT"-10/bx.		1.89

* pre-packaged with 3M's Flip 'n File/15

DC-100A	11.79	DC-300XL/P	18.65
DC-1000	12.40	DC-600A	20.65
3M H/C Kit	5.99	3M Flip 'n File/15	4.42

BASF FlexyDisk — qualimetric — Recieve 20% FREE Goods BASF "Boxed Products"

5.25"	Reg. Price	100 + Net Price*
SS-DD-48 TPI-10/bx.	.82	.68
DS-DD-48 TPI-10/bx.	.88	.73
DS-HD-96 TPI-10/bx.	1.79	1.49
3.50" SS-135 TPI-10/bx.	1.79	1.19
3.50" DS-135 TPI-10/bx.	1.79	1.49

*Net price reflects 20% FREE goods

UNBELIEVABLE PRICES!

Nashua Boxed

SS-DD	Qty less than 10 BX. add 10%	DS-DD
.49	5.25"/48 TPI-10/bx.	.52
1.10	3.50" 135 TPI-10/bx.	1.43
DS-HD 96 TPI for the "AT"-10/bx.		1.45

COLOR DISKETTES

Receive up to 25% FREE GOODS! on color diskettes!!

14 different colors

5.25"	Reg. Price	100 + Net Price*
DS-DD 48 TPI	.69	.55
DS-HD 96 TPI for the "AT"	1.89	1.57
3.50" DS-135 TPI	1.89	1.57

*Price reflects up to 25% FREE goods. Includes Tyvek® sleeves, color-coded ID labels, w/p tabs, and reinforced hub ring. 10 mil sturdy jacket. 75% clipping 100% tested & certified USA made. LIFETIME WARRANTY

RIBBONS

EpsonMX/RX/FX70/80/85	2.35	3M Discover 50	6.99
Epson MX/RX/FX 100/185	3.15	3M D/Defender070 w/key	13.95
Epson LQ1000	4.99	3M Data Defender050	13.95
Epson LQ1500	3.99	Disk Minder II-75	5.99
Okidata Twin Spool	.99	Amaray Media Mate 50	8.90
Okidata 182/192/193	3.99	Amaray Micro Mate 3	8.70
Apple Imagewriter	2.39	Plastic Library Case	1.50
IBM Proprinter	3.99	Micro Disk Minder 36	8.70

STORAGE

CALL FOR OUR SUPER LOW PRICES ON COMPUTER TAPES, DISK PACKS. **Terms:** VISA, M/C, AMEX. P.O., COD. Prepaid 2% cash discount Net 30. Shipping $3.00/100 or fewer disks. Reduced shipping charges on larger quantities. APO/FPO, PR, HI, AK & CN $8.00/100 or fewer disks. Overseas order call for exact freight charges. Same day shipping.

SATISFACTION GUARANTEED

Toll-Free Order Line: 1-800-523-9681 **Telex** 9102404712 **Inquiries Line:** 1-801-942-2273

DISKCOTECH

DISKCO TECHNOLOGIES, INC.

2034 E. 7000 So. Salt Lake City, Utah 84121

Hours: 8 AM-6PM (Mtn. Time)-Half day Saturday

Inquiry 90

EPROM PROGRAMMER $349



The EP-1 is a great value, here's why:

- IBM PC Software included or RS-232 to any computer
- ASCII Command driven operation; All intelligence in unit
- Reads, Programs, Copies over 150 types from 2716 to 27512
- Optional Intel microcontroller programming head
- Menu-driven Chip Selection; No Personality Modules
- Fast, Slow, Quick-Pulse Programming Algorithms
- Intel (8080 & 8086), Motorola, Tekhex, Straight Hex Files
- Splits Files by Base Address and Odd/Even (16 bit systems)
- Gold Textool ZIF IC socket
- Generate & Set Checksums
- Over-Current Protection
- 8 Baud Rates 300 to 38,400
- Full One-Year Warranty
- 5,12.5,21,25V Programming
- U.V. Erasers from $34.95
- Same Day Shipment

BP MICROSYSTEMS

10681 Haddington, #190 / Houston, TX 77043

(713) 461-9430 (800) 225-2102

Inquiry 43

BULK DISKETTES

MAXELL

5¼ DS/DD 59¢

Price based on quantity of 250

Includes sleeves, labels and tabs

Quantities Limited Call Today!

800-222-0490

(In N.J. 201-462-7628)

Full service duplication facility

24 Hour Shipment

MEGASoft

P.O. Box 710

Freehold, N.J. 07728

Inquiry 184

8051 8048

SIMULATORS – CROSS ASSEMBLERS – PROGRAMMERS – SIM51 and **SIM48** Software Simulators run on IBM-PC, CP/M-80, MS-DOS. Designed for validation & debugging application software. Simulation includes all on chip functions plus expansion chips. $250, one year **FREE** updates. Formats: PC-DOS 2.x DSDD, CP/M-80 8" SSSD, many 5¼" formats. Cross Assemblers and EPROM pgmrs also available. **Logical Systems Corp.** 6184 Teall Station, Syr., NY 13217. (315) 478-0722.

Logical Systems

Inquiry 168

PC/XT USERS!

COGTREE Utilities by Cogitate	$129.95
LYNC by Norton-Lamber	$199.95
DATAFLEX by Data Access	Varies
RM/COBOL by Ryan/McFarland	Varies
Universe by Omnitrend	$ 98.50
Blue Mac! by Cogitate	$599.00
CadPower+ by Trilex	$995.00
Softext Teaching Aids	$ 95.00
PrintSet by Cogitate	$ 79.95
CogiTAPE by Cogitate	CALL!!
Anti-Static Products	Varies
Uninterruptible Power Backups	Varies
TeleVideo Software	CALL!!

COGITATE

"A Higher Form of Software"

24000 Telegraph Road

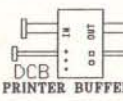
Southfield, MI 48034

(313) 352-2345/Telex 386581

VISA/MASTERCARD ACCEPTED

Dealer Inquiries Welcomed

Inquiry 59



! not only a printer buffer !

THIS IS THE MOST SOPHISTICATED PRINTER BUFFER – MULTIPLEXOR – SWITCH

WITH TWO SEPARATE INPUTS (SERIAL AND PARALLEL) AND TWO SEPARATE OUTPUTS (SERIAL AND PARALLEL) CAN BE USED LIKE STANDARD BUFFER... WITH ANY INPUT TO ANY OUTPUT... BUT ALSO YOU CAN CONNECT 2 COMPUTERS TO 1 PRINTER, OR 1 COMPUTER TO 2 PRINTERS, OR 2 COMPUTERS AND 2 PRINTERS... AND MORE = 1 COMPUTER TO 3 PRINTERS OR 3 COMPUTERS TO 1 PRINTER.
HIGH CAPACITY – 64 KB TO 256 KB AND – 256 KB TO 1 MB (MODELS A AND B). PAUSE, COPY AND RESET FUNCTIONS. SERIAL PORTS WITH 7 OR 8 BITS WORD LENGTH, 1 OR 2 STOP BIT, PARITY, XON/XOFF, DTR, RTS.

DCB-A-64K $ 195 DCB-B-256K $ 255 (*)

(*) Power supply and parallel cables are included.

ALSO, WE HAVE THE MOST COMPLETE DATA CONVERTER UNIT CONVERTS RS232 SERIAL TO CENTRONICS PARALLEL OR VICE VERSA, JUST BY MOVING JUMPERS. BAUD RATE AND PROTOCOL FULLY PROGRAMABLE FROM 150 TO 19200 BAUDS INCLUDES: DTR, RTS, XON/XOFF, PARITY, etc

DCU $ 80 (**)

(**) Power supply and cables NOT included

MasterCard VISA



serial◇parallel bi–directional converter

INTECTRA

INTECTRA Inc.–Dept.232

2520 TERMINAL BLVD

MOUNTAIN VIEW-CA-94043

(415) 967–8818 TX 345545

Inquiry 144

coldblue™



A Ventilation System designed to prolong the life of IBM® PC PC/XT. Coldblue™ fits in the IBM enclosure reducing operating temperatures as much as 27°F by increasing airflow across the card area.

The one that really works! **$185.**

Mandrill Corp. PO Box 33848, San Antonio, TX 78265 800-531-5314

Dealers inquiries welcome.

Inquiry 176

TIMELINE INC.

20 MILLION I.C.'S IN STOCK!
Minumum I.C. Order: $200.00

Order Desk
Continental U.S.A (800) 872-8878
Inside California (800) 223-9977
L.A. & Technical Info (213) 217-8912
OEM INQUIRIES WELCOME

THE BEST EGA BUY OF THE CENTURY!

$699.00

BOARD FEATURES:

- **Multiple Modes:**
  - CGA: 320 x 200 - **ENHANCED TO 640x400**
  - EGA: 640 x 350 - **ENHANCED TO 640x400**
- PGA RESOLUTION: 640x480 USING MICROSOFT WINDOWS, LOTUS,AUTOCAD,PCAD, ETC.
- HERCULES: 720x350
- AUTOSWITCH
- PARALLEL PRINTER PORT

MONITOR FEATURES:

- 13" DIAGONAL VIEWING AREA/NON-GLARE SCREEN
- MATRIX PITCH: 0.31mm/BLACK MATRIX
- ADDRESSABILITY: 640 HORIZONTAL x 480 VERTICAL
- PGA COMPATIBLE- OPERATES WITH SEPERATE RED, GREEN & BLUE ANALOG SIGNALS AND CAN SUPPORT AN INFINITE NUMBER OF COLORS.

INCLUDES:
EGA CARD,MONITOR, CABLES & SOFTWARE



Call for Dealer Prices (10 or more)

If this monitor looks familiar, you have probably discovered one of the reasons why this is the best deal of the century. This incredibly built display was manufactured by the most prestigious company in the industry. Along with Classic Technology's™ new EGA adapter using Paradises™ single chip (PEGA II)™ combined with Paradise's™ BIOS, we are able to bring to market the most spectacular EGA package in the industry. IMAGINE YOUR CGA SOFTWARE RUNNING AT BETTER THAN EGA RESOLUTION

IBM COMPATIBLE FLOPPY DISK DRIVES

DS/DD
360 K
5¼" ½ HEIGHT

YOUR CHOICE

QUME TRACK 142
BELT DRIVE
$65.00

MITSUBISHI 4851
DIRECT DRIVE
$89.00 (2 to 10 - $79.00)



ASTEC 65 WATT SWITCHING POWER SUPPLY

Dual input voltage 115/230 VAC · Overvoltage protection · Short circuit protection · Dual isolated +12V · Built-in EMI filter · Very compact size · UL/CSA/VDE approved · 100% thermal cycle & burn-in · High efficiency · Vaccum impregnated transformers · Convection cooling · Open PCB "L" bracket or boxed construction.

Dimensions: 8.0" · Length 4.4" · Width 2.4" · Height

OUTPUTS:	+ 5V DC@ 6.0A	+5V DC@ 5.0A(with two + 12V outputs in parel"
Condition No.1	+12V DC@ 1.5A	+12V DC(with two + 12V outputs in parallel)
	+12V DC@ 2.1A	@3.5A (5.0A surge)
	−12V DC@ 0.25A	−12V DC@ 0.25A

Condition No.2

MODEL No. AC9338-01

$29.95



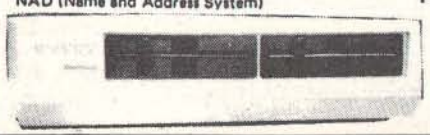
Multitech 504 CP/M SYSTEM

INCLUDES: 2 96 tpi drives Z80A Microprocessor
Ports: Centronics parallel,Two serial JUST ADD A TERMINAL!
Single board, 64K

$299.00

Comes with all software & manuals: Magic Worksheet, Word Right, Analyst,QSORT, NAD (Name and Address System)

THEY'RE BACK!
But only 30 are left. Act now, they'll go fast!



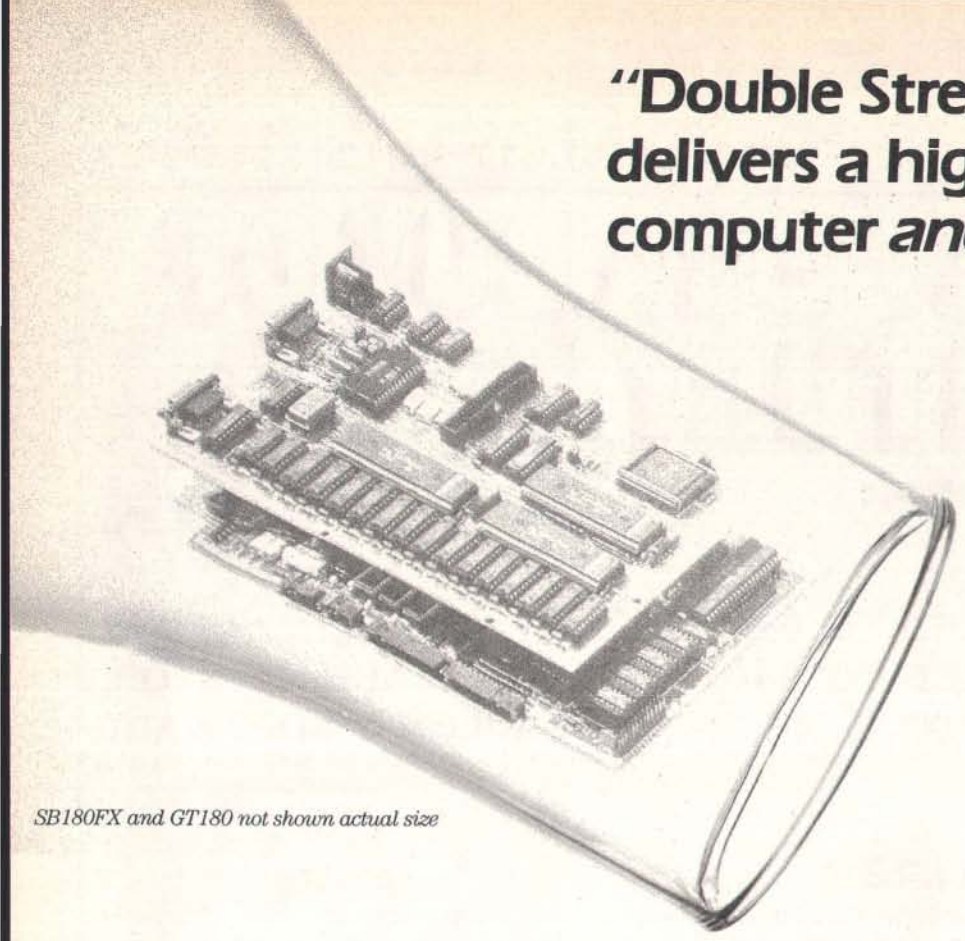
TIME LINE

1490 W. ARTESIA BLVD., GARDENA, CA. 90247
Continental U.S.A. (800) 872-8878
Inside California (800) 223-9977
L.A. Area & Technical Info (213) 217-8912

VISA MasterCard

Minimum Order: $25.00. Shipping & handling charges via UPS Ground: $.50c/lb. UPS Air: $1.00/lb. Minimum Charge: $4.00. We accept cashiers checks, MC or VISA. No personal check COD's. Items reflect 5% cash or check discount. California residents add 6½% sales tax. We are not responsible for typographical errors. All merchandise subject to prior sale. Phone orders welcome. Foreign Orders require special handling Prices subject to change without notice. 15% Restocking fee for returned orders

"Double Strength" Solution delivers a high performance computer *and* power graphics!



SB180FX and GT180 not shown actual size

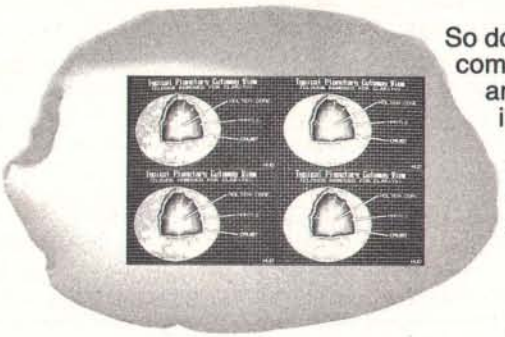
You've needed a computer that's smaller, faster and packs more memory. And you've wanted the best of today's graphics. Well, now you can have both affordably. Micromint brings you its newest single board computer, the SB180FX and its piggy-back color graphics board the GT180. Now with this "double strength" combination you can take industry standard Z-80 compatible software and add colossal graphics like the ones you see on this page. That's right—*graphics like these with your Z-80 software!*



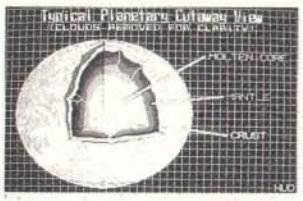
The GT180 has 38 commands including 23 graphics drawing commands: line, rectangle, polyline, polygon, circle, ellipse, arc, ellipse arc, filled rectangle, paint, pattern and copy.

Resolution of the GT180 is 640x480x16 colors with a palette of 4096.

The SB180FX is only 5.75" x 8". It gives you a Z-80 compatible CPU running at 6, 9 or 12 mHz. You also can get 512K bytes of RAM, up to 32K bytes of ROM, two 38.4K baud serial ports, a parallel port, a peripheral expansion bus, three bi-directional parallel ports and an industry standard 765A-compatible disk controller for up to four disk drives (any combination of 3½", 5¼" or 8" drives). An on-board SCSI expansion bus lets you connect directly to a hard disk drive or additional computers.



Three horizontal split screens and one window screen. Size and position fully programmable.



Software: Modula 2 by Borland International including SB180/GT180 Grafix Toolbox.

So don't wait any longer for the computer size, speed, memory and graphics you've been waiting for. The SB180FX and GT180 team not only gives you the latest features you're looking for, you can have them for a great low price.



SB180FX* . . .starting at $409.00
GT180 . . . . . .$395.00
Borland International
Turbo Modula 2. . . . . **.$69.00**
Modula 2 Grafix Toolbox **.$89.00**

*minimum configuration: 256K bytes of RAM and ROM monitor.

TO ORDER CALL

1-800-635-3355

for technical information or in Connecticut call: 1-203-871-6170

Micromint, Inc. 4 Park Street Vernon, Connecticut 06066 TELEX: 643331

Programming Credit: Tom Hudson

Multitech Accel 900

* 6/10mhz Switchable speeds
* AT Compatible * 8 Slots
* 80286 Processor * 1.2MB Floppy
* 30 Meg Hard drive * 512K Ram
* Monochrome Graphics/soft-white display
* 2 Parallel, 2 serial, clock/Calender
* DOS 3.1

$2449

TURBO XT Compatible 20MB Computer

* 640K * 1 Floppy drive.
* ser, par, clk/cal * 8 Slots
* Monographics * Monitor
* DOS 3.2
* FCC Approved

$1199

4.77mhz Floppy Drive XT Compatible Computer

* 640K Ram *2 Floppy drive
* ser,par,clock * 8 slots
* Monographics * Monitor
* Dos 3.2
* FCC Class B approved

$829

SYSTEMS

Multitech Plus 700 2 drives	775.00
XT 8mhz Turbo 20MB	969.00
XT 4.77mhz Floppy Drive System	669.00
IBM PC AT 8Mhz 30MB Drive, 512K	CALL
IBM PC XT 20MB drive, 640K	1669.00
Sperry IT 44MB drive, I Meg	2,800.00
Compag Deskpro 286 30MB drive	2,999.00
Toshiba Systems	CALL

IBM SOFTWARE

LOTUS 123	CALL
ASHTON TATE dBASE III Plus	CALL
Q & A	CALL
CLIPPER dBASE III Compiler	355.00
LET'S C Compiler	49.00
SUPERCALC IV	275.00
MULTIMATE ADVANTAGE	CALL
MICROSOFT Word	CALL
Windows	65.00
DOS 3.2 W/GW basic	69.00
BORLAND TURBO PASCAL W/Bcd	60.00
REFLEX	CALL
LIGHTENING	59.00
NORTON UTILITIES	55.00
FASTBACK	95.00
CROSSTALK XVI	99.00
MIRROR Comm Software	49.00
PEACHTREE Back to Basics	199.00
OPEN SYSTEMS	CALL
BPI General Accounting	299.00
ACCOUNTING PARTNER	199.00
MONOGRAM DOLLARS & SENSE	99.00
TOBIAS MANAGING YOUR MONEY	99.00
DAC EASY ACCOUNTING	45.00
PFS Professional Write	115.00
PFS Professional File	145.00
SATELLITE WORD PERFECT	209.00
WordStar 2000 PLUS	299.00
GENIFER	CALL
FUNK SIDEWAYS	39.00

HARDWARE

AST 6 pack premium W/256K	289.00
RAMPAGE	CALL
HERCULES MONO Graphics Plus	195.00
Intel Above Board	CALL
JRAM 3	CALL
Microsoft Mouse W/Sftwr	117.00
Mouse Systems Mouse	119.00
Turbo 286E	749.00
Genoa spectrum	SAVE
Paradise Autoswitch EGA	388.00
Quadram EGA+	349.00
Multifunction card 384K,S,P,Clk	139.00
AT Multifunction card 0K-3MB	175.00

DRIVES/TAPE DRIVES

20 MB Seagate drive	369.00
30 MB Seagate for XT	449.00
30 MB drive for AT	625.00
360 K Floppy for AT	110.00
Teac 55B	99.00
20 MB Hard Card	429.00
Plus Hard card	CALL
Mountain Hard card	CALL
10 MB Irwin	329.00
Everex Stream 20	569.00
GENOA 60MB tape B/U	SAVE
ALLOY	CALL

PRINTERS

PANASONIC KX-P1080i	CALL
KX-P1091i	SAVE
KX-P3131 17cps Daisy	249.00
Citizen MSP-10	275.00
EPSON All Models	CALL
BROTHER-1509	369.00
HR-20 Daisy wheel	369.00
OKIDATA-All Models	CALL
TOSHIBA All Models	CALL
CANNON Laser Printer	1,999.00
HEWLETT PACKARD LAZER	2,199.00
HOUSTON INSTRUMENTS	CALL

MONITORS/MODEMS

Amdek 310 A	149.00
Color 722 RGB 720 X 350	499.00
Princeton Graphics HX-12	399.00
HX-12E (Enhance graphics)	499.00
MAX-12	149.00
TAXAN all models	CALL
NEC Multisync	CALL
IBM Compatible Monocrome	89.00
Color RGB Monitor (640 X 200)	269.00
Anchor Lightining 2400	299.00
Volksmodem 1200 (5 yr wrnty)	139.00
Volksmodem 1200 Internal	120.00
Hayes 1200	379.00
2400	CALL
Prometheus 2400	359.00
Promodem 1200	239.00
Promodem 1200B	179.00

COMPUTERBANC

6951 Warner Ave., Huntington Beach, CA 92647

TM

Cash prices indicated. We guarantee all items for 30 days. Within this period, defective merchandise returns must be accompanied by RMA number. All other returns will be subject to a 15% restocking fee. For prepaid orders, there will be a 3% shipping charge; 5% for UPS Blue Label; $5.00 minimum; California residents add 6% sales tax.

ORDERS ONLY 800-322-BANC **OUTSIDE CALIFORNIA**

714-841-6160 TECH SUPPORT 714-847-BANC

VISA MasterCard

Prices are subject to change W/O Notice
©Copyright 1985 Computerbanc
All rights Reserved

CALL FOR COMPLETE CATALOG

LOW COST HIGH RESOLUTION DATA LOGGING for IBM PC/XT/AT®

15-Bit four input channel system 7 samples/second with hardware and menu driven software $415

Expand system above by 15 analog input channels (64 max.)... $165

Add thermocouple thermometry to above, 6 channels for..... $175

Add 16-bit, 12,000 sample/second capabilities to above for... $210

Call for quantity pricing or for quotes on custom hardware, software or complete systems.

LAWSON LABS, INC.
5700 Raibe Road
Columbia Falls, MT 59912
Phone: 406 387-5355

Inquiry 163

PC Compatible CASH DRAWERS



M-S CASH DRAWER
10711 Flower St., Stanton, CA 90680
(800) 544-1749
In California call:
(714) 821-1133

Inquiry 198

ROSE ELECTRONICS DATA SWITCHES



SHARE computers, printers, any parallel or serial device
ELIMINATE cable swapping
INEXPENSIVE way to network
COMPATIBLE with all computers.

Businesses, Schools, Homes

WE ALSO OFFER:
Data Buffers, Line Drivers, Modems, Protocol Converters, Parallel - Serial Converters, Cables, Computers, Printers, Disk Drives, and more.

AUTOMATIC - **CARETAKER** is ideal for a business or school to share a printer or modem among many computers. Operation is fully automatic with no software required.
Parallel or Serial 4 channels - $295 8 channels - $395

MANUAL - **HARDSWITCH** is operated with the flip of a switch. 2:2 and 2:4 models allow simultaneous communication.

Serial	1:2 - $59	1:4 - $ 99	2:2 - $109	2:4 - $169
Parallel	1:2 - $79	1:4 - $139	2:2 - $119	2:4 - $199

LED and spike protection on serial models add $20.

CODE ACTIVATED - **PORTER** connects one computer to multiple peripherals. A software code selects the peripheral.
Parallel or Serial 4 channels - $295 8 channels - $395
Buffer option 64K - $100 256K - $250

REMOTE - **TELEPATH** connects multiple computers to multiple peripherals. A selector at each computer or terminal chooses up to 4 peripherals and displays busy status.
4:4 - $495 4:8 - $795 selector - $39.

Give a Rose to your computer

ROSE ELECTRONICS (713) 933-7673
P.O. BOX 742571 MC & VISA Accepted
HOUSTON, TX 77274 Dealer Inquiries Invited
CALL US FOR ALL YOUR INTERFACE NEEDS

Inquiry 262

DiskMASTER®

The Ultimate Diskette Value ...



Discover The Difference ...

2 FOR 1 LIFETIME WARRANTY

- *Performance exceeds ANSI specifications by 62.5%*
- *Each diskette 100% tested and certified error free*
- *65% clipping level* • *Over 10 million passes per track*
- *Reinforced Hubs (DS-DD only)* • *Tyvek® sleeves*
- *W/P tabs and ID labels*

.49 5¼" - 48 TPI DS-DD

1.09 DS-HD 96 TPI IBM-AT Compatible

Simply top Brand-Name Quality, made in the U.S.A. by a leading manufacturer. Factory polybagged in lots of 25 (min order 50)

CENTECH® *America's Premium Quality Color Diskettes*

- *TIMELESS WARRANTY*
- *Performance exceeds A.N.S.I. specifications by 88%*
- *Each disk 100% tested and certified*
- *14 COLORS for data organization*
- *Pkgs. of 10, tyvek sleeves, w/p tabs, and ID labels*

SS-DD	QTY. 10 BOXES OR 100 DISKETTES	DS-DD
.74	5¼" Color, BOXED, 48 TPI	.98
1.39	3.5" Color, BOXED	1.95
.64	5¼" Color, BULK, 48 TPI	.88
1.30	3.5" Color, BULK	1.92
High Density, Color, 1.6mb, IBM AT Compatible		1.85

Includes Tyvek sleeves, w/p tabs, and ID labels. **FREE** Financial Calculator Software. Call for details.



America's No. 1 Name-Brand Diskettes

- *LIFETIME WARRANTY*
- *High quality and consistently reliable*
- *More rigid jackets than ever before*

SS-DD	QTY. 5 BOXES	DS-DD
.74	5.25, 48 TPI	.97
1.35	3.5, 135 TPI	1.90
DS-HD 96 TPI, IBM AT Compatible		1.95

Call for best 3M prices on head cleaning and data cartridges.

Nashua™ *Affordable Quality Incredible Value Best Prices Ever!*

- *LIFETIME WARRANTY*
- *Factory Fresh in **BOXES** of 10 with sleeves, w/p tab, ID labels*

SS-DD	QTY. 10 BOXES	DS-DD
.54	5.25, 48 TPI, box of 10	.57
1.12	3.5", 135 TPI	1.46
High Density, IBM PC-AT Compatible		1.50

BULK SPECIAL OF THE MONTH *Made in U.S.A.*

- *LIFETIME WARRANTY*
- *Exceeds ANSI specifications*
- *Includes Tyvek sleeves and w/p tab*
- *Hub Rings*
- *100% tested and certified*
- *Made in USA*

BULK *MULTIPLES OF 100*

5¼ DS-DD **35¢**

ORDERING INFORMATION

TERMS: Free use of VISA, Mastercard, and American Express. P.O. orders accepted from recognized corporations rated 3A2 or better, government and schools on net 30. **SHIPPING:** Add $3.00 per 100 diskettes or fraction thereof, add $5.00 for COD orders.
PRICE PROMISE: We will better any lower delivered price on the same products and quantities advertised nationally.

Toll Free Order Line: **1-800-233-2477**
Information Line: **1-801-561-0092**

Computer Affairs, inc.
199 Cottage Avenue
Salt Lake City, Utah 84070
Hours: 8am to 5pm (mtn. time)

6809 Single Board Computer



6809 MPU, 2 serial ports, 4 parallel ports, RAM, EPROM, real-time clock, watchdog timer, 44-pin 4.5" × 6.5" PCB
EXPANSION MODULES: RAM, EPROM, CMOS RAM/battery, analog I/O, serial I/O, parallel I/O, counter/timer, IEEE-488, EPROM programmer, floppy disks, cassette, breadboard, keyboard/display.

WINTEK
Wintek Corp.
1801 South Street
Lafayette, IN 47904
317-742-8428

Inquiry 333

COLOR

VT220 $150

***plus your PC, XT, AT, or compatible**

ZSTEMpc-VT220 Smart Terminal Emulator
Double high/double wide characters
Full line graphics. Smooth Scrolling
2-way file transfers incl. XMODEM & KERMIT
Full keyboard softkeys/MACROS. DOS access
Data rates to 38.4 KB. High throughput
CGA, Hercules, MDA, & EGA support
8-bit mode, downloadable fonts,
user defined keys, full national/multinational modes
ISO and attribute mapped color
ZSTEMpc-VT220 $150. 4010/4014 option $99.
Available soon: VT220 Style replacement keyboard
ZSTEMpc-VT100 $99. - Choice of the U.S. A/F
30 day money back guarantee. MC/VISA

KEA SYSTEMS LTD.
#412 - 2150 W. Broadway
Vancouver, B.C. CANADA V6K 4L9
Support (604) 732-7411
TELEX 04-352848 VCR

Order Toll Free (800) 663-8702

Zstem by KEA SYSTEMS

Inquiry 347

Smart Cash Register $95

Turns MSDOS computer into complete RETAIL POS SYSTEM

TURBO PASCAL program — 100% dBASE compatible files
All transactions logged to disk
Transfer data to 123, dBASE, BASIC, PASCAL etc.
PLU/Inventory Table to 32000 items
4-character DEPT — 5-character MFR, PROD
Cashier security — Auto/Manual discount, tax
End-Shift summary — Custom Receipts 20/40/80 col
HARDWARE SUPPORT: — Cash Drawer BarCode Reader
Receipt Printer — Function-button Keyboard

ORDER: 915-837-7180

Inquiry 272

TERMINAL EMULATIONS

NEW RELEASE **SOFTERM PC, THE LEADER IN EXACT TERMINAL EMULATIONS**

* OVER 30 EMULATIONS
* KEYBOARD MACROS
* HOTKEY
* VIRTUAL DISK CAPABLE
* SCRIPT FILES
* KEYBOARD TRANSLATE
* MULTITASKING
* CAPTURE FILES TO DISK OR PRINT
* FILE TRANSFERS WITH 7 PROTOCOLS (I.E. KERMIT-SERVER,HAYES,XMODEM,ETC.)
* CONCURRENT AND BACKGROUND COMMUNICATIONS AND MORE!!!

A COMPLETE EMULATION & COMMUNICATION PACKAGE

SOFTRONICS
800/225-8590
CALL FOR INFORMATION
(303)593-9540 TELEX 450236

Inquiry 285

PC + MIDI = MUSIC

It's a simple equation. To plug your PC or PC-compatible into the modern world of music-making, use the complete line of MIDI soft ware and hardware from **VOYETRA TECHNOLOGIES.**

- ☐ **SEQUENCER PLUS:** 65-track total MIDI recorder/editor.
- ☐ **CONVERSION PLUS:** file converter for music notation programs.
- ☐ **PATCH MASTER:** network organizer and sound librarian.
- ☐ **OP-4001:** PC/MIDI interface card.

"I've never seen a more powerful, easy-to-use music and recording system . . . bug-free." (PC COMPANION)

For more information contact **VOYETRA TECHNOLOGIES,** Dept. PC, 426 Mt. Pleasant Avenue, Mamaroneck NY 10543, or call (914) 698-3377.

Inquiry 325

SOFTWARE DUPLICATION SERVICES

XEMAG®
THE TOTAL SOLUTION

- World's Largest Duplicator
- Highest Quality
- Fastest Turnaround
- Attractive Cost Savings
- One-Stop shopping
- Copy Protections for all formats
- Professional Engineering Support
- Branches Nationwide
- A Division of ***XIDEX*** Corp.

CALL 1-800-233-5099

Inquiry 338

pinecom™ . . . . . IBM Compatibles

2 SPEEDS TURBO SYSTEM
FULLY IBM PC/XT COMPATIBLE 4.77/8MHZ



- 640K on Board RAM
- 2 Floppy Disk Drives
- Disk Controller Card
- 150W Power Supply
- FCC Type Slide Case
- 'AT' Style Keyboard
- 8 IBM I/O Slots
- 8088-2 Micro Processor
- 8087 Co-Processor Socket
- 4.77 MHZ/8MHZ Clock Selectable
- Monitor and Display Card Not Included

Fully Assembled and Tested **$560.00**
(Other Options and Configurations Available, Please Call.)

PINECOM AT SYSTEM
FULLY IBM AT COMPATIBLE



- 8/6 MHZ Clock Selectable
- 80286 CPU
- 1.2 MGB Floppy Drive
- 200 Watts Power Supply
- Hard Disk/Floppy Disk Controller
- 512K RAM Expandable to 1 MGB
- Clock Calender w/Battery Backup
- 'AT' Style Keyboard

Fully Assembled and Tested **$1199.00**
30 MGB (ST-4308) Hard Disk $620
Other Options, See Below

TURNS YOUR 'XT' Into an 'AT'
PCI-286 SPEEDCARD
For IBM PC/XT Compatibles

- 80286/8088 Microprocessor Switch Selectable
- 7.2MHz Clock Speed
- 8K Cache Memory
- 7.5 Times Faster Than PC/XT
- Math Co-Processor 80287 (5/8MHz) Optional
- Fully DMA Compatible
- Runs All AT/XT Software
- Easy To Install, No Soldering Required



$389.00

SALES ITEMS

20 MGB Hard Disk (Seagate ST-225) (79 MS)	$290.00
Western Digital Hard Disk Controller Card WX-2	$100.00
30 MGB Hard Disk For 'AT' (ST 4038) (39 MS)	$620.00
Half Size Modem Card 300/1200 BPS Hays Compatible (Logictech)	$125.00
3 Button Mouse System with Software (Serial)	$85.00
TTX 1411 RGB Monitor 14" 0.39 Dot 640 X 250	$330.00
Samsung 12" Monochrome TTL Monitor, Amber or Green	$89.00
Samsung 12" Monochrome Composit Monitor, Amber	$75.00
Monochrome Graphic Adapter with Printer Port	$85.00
Color Graphic Adapter with 2 Composit Output	$70.00
0/576 K Max. RAM Expansion Card For PC/XT	$45.00
Fujitsu 360K Half Height Floppy Disk Drive	$88.00
Joystick with 2 Fire Buttons For IBM	$18.00
6 Outlets Power Strip with Surge Suppressor and Main Sw.	$18.00
8087-3 Co-Processor Chip For XT (4.77 MHZ)	$115.00
8087-2 Co-Processor Chip For XT Turbo (8 MHZ)	$168.00
80287-8 Co-Processor Chip For AT (8 MHZ)	$299.00
NEC V-20 Processor (Replace 8088) 40% Faster	$13.00
NEC V-20 Processor (Replace 8088-2) 150% Faster	$18.00

SUPRA TURBO SYSTEM

- 640K RAM on Board 4-77/8MHz Motherboard
- 360K Floppy Disk Drive w/Controller
- 20 MGB Hard Disk w/Controller
- 150 Watts Power Supply
- Mini 'AT' Style Case With Key Lock
- Front Panel LED for Power, Hard Disk and Turbo Mode
- Hardware Reset Button on Front Panel
- 'AT' Style Full Function Keyboard (5060)
- Monochrome Graphic Card w/Printer Port
- 12" Hi-Res Amber or Green T.T.L. Monitor
- NEC V-20-8 Processor Used (330% Faster than IBM PC)**



**Based on Norton Utility Program, System Information's Result.

FULLY ASSEMBLED AND TESTED **$1132.00**

BTC 5339 (5152)
12 FUNCTION KEYS ENHANCED KEYBOARD FOR IBM PC/AT

FOR AT or XT
BTC-5339



$78.00

- Positive Tactile Feedback
- Solid State Capacitance Low-Profile key switches
- Separate Cursor Key Pad
- Separate Numeric Key Pad
- Enlarged Return Key With LED Indicator for Shiftlock
- 12 Function Keys Supports DOS 3-2

IMAGE ACE II VIDEO CAPTURE CARD

ACE-II



$275.00

Captures video from video camera or TV, transfer to your PC computer, can display on your monitor, storage on disk, or transmits it out via modem to other user. Requires color graphic card. Install to any empty slot on your computer. Software and instruction included.

3 MGB MULTIFUNCTION CARD FOR 'AT'



#MF-3000
$184.00

- User Expandable Up to 3 MGB with 128/512K Increments
- One RS-232 Serial Port (2nd Port Optional)
- One Parallel Printer Port
- One Game Port

RAM Set (Each 1MB) $108.00
2nd Serial Port I.C. Set $26.00
Shipped With Zero K RAM

2 MGB RAM EXPANSION CARD FOR 'AT/XT'

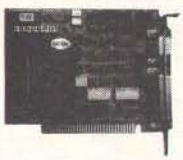


$147.00 #MEMO-2000-XT
#RAM-310-AT

- Confirms to Lotus/Intel Expanded
- Memory Spect. (EMS)
- Up to 2048K Bytes of Expansion Memory
- Uses 64K or 256K RAM Chips
- Software and Instruction Manual Included

Memory Set (Each 1MB) $108.00
Shipped with Zero K RAM

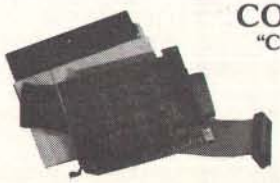
4 SERIAL PORTS (RS-232) ADAPTER



MS-400-XT
$92.00
MS-400-AT
$125.00

- 4 Serial Ports COM-1, COM-2, COM-3, COM-4
- Custom Fully Molded Serial Cabling and Mountings
- Short Card Design, Available For 'AT' or 'XT'

COPY II PC OPTION BOARD
"Copies Virtually All Protected Software"



For IBM XT/AT, Comes with Disk Back Up Utility, Copy II PC Board, Cable and Instruction

$99.00

PINE COMPUTER INC.

9690 Telstar Ave., Suite 204
El Monte, CA 91731

Phone: (818) 575-1882
Telex: 5106017376 PINECOM

TERMS: COD accepted on cashiers check or cash. Visa or Master Charge accepted with 3% surcharge. Shipping charges for COD orders = 5% of total purchase, 2% for prepaid orders, minimum charge applied.

*IBM is registered trade mark of IBM Corp.

Serial ◀▮▮▮▮▮▮▮▮▶ Parallel

NEW!



Convert What You Have To What You Want!

* RS232 Serial
* 8 Baud Rates
* Latched Outputs
* Centronics Parallel
* Handshake Signals
* Compact 3¼ × 4⅝ × 1½

No longer will your peripheral choices be limited by the type of port you have available! Our new High Performance 700 Series Converters provide the missing link. Based on the latest in CMOS technology, these units feature full baud rate selection to 19.2K, with handshake signals to maximize transfer efficiency. Detailed documentation allows simplified installation. Order the Model 770 (Ser/Par) or Model 775 (Par/Ser) Today!

Buffer Products Coming Soon!

Tigertronics

only $89.95

Connector Option $10.00
CA Residents 6% tax
UPS Shipping $3.00

2734-C Johnson Dr.
Post Office Box 3717
Ventura, California 93006

CALL (805) 658-7466 or 658-7467
For FAST Delivery

MasterCard VISA

Inquiry 308

8051 PASCAL CROSS COMPILER

For MS-DOS Computers

SCIENTIFIC ENGINEERING LABORATORIES
104 Charles Street, Suite 143
Boston, MA 02114 Tel 617 262 3903

Inquiry 271



P C HORIZONS, INC.
1701 E. Edinger, Ste. A6, Santa Ana, CA 92705
(714) 953-5396

Inquiry 222

Tune-up your hard disk!

Vopt™ DISK ORGANIZER

FAST — EFFICIENT

Vopt organizes your hard disk into contiguous files for fast, efficient, time-saving use! Initial organization averages under 5 minutes; daily runs average under 1 minute!

CONVENIENT

Run it from your autoexec.bat file!

SAFE

Vopt's contiguous files are easier to recover if accidentally deleted! **Vopt**'s speed allows files to be moved one-at-a-time, rather than taking chances on disk reliability. Detects and maps bad sectors.

GOLDEN BOW SYSTEMS

$49.95
Add $3 for S&H
California Residents add 6% Sales Tax



2870 Fifth Avenue
Suite 201
San Diego, CA 92103
619/298-9349

Inquiry 123



PORTABLE ADDITIONS

DISK DRIVE *3½", 1¾ lbs., battery oper. or A/C adaptor (incl.), 100K storage. With TS-DOS software* ***$229*** *Drive without software* ***$179***

24K RAM CHIP—*Tandy 200* ***$65,*** *2/$59 ea.*

8K RAM CHIP—*Model-102* ***$9.95***
Model-100 & NEC 8201/$23 3/$19 ea.

SIDESTAR—*NEC Starlet* ~~$399~~ ***$199***
128K Ram Disk Cartridge

SIDECAR—*NEC PC-8201A* ***$259***
128K cartridge (four 32K banks)

CALL TOLL FREE 1-800-732-5012
Calif: 805-987-4788
Canada: 604-856-8858, Australia: 02-419-8899

PURPLE COMPUTING — VISA M/C & AMER.EXP.

420 Constitution Ave., Camarillo, CA 93010

Inquiry 240

Perfect your

WordStar

with

MagicSeries

- Perfect proportional spacing
- Multi-line headers/footers
- Column printing
- Footnoting
- File merging
- Indexing/table of contents
- LaserJet/daisywheel versions

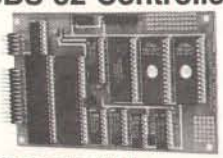
$99 **$149** **$199**

CES 800-251-2223

509 Cathedral Pkwy. 10A
New York, NY 10025
212-222-8148

Inquiry 72

Single Board Systems
Introduces
SBS-52 Controller

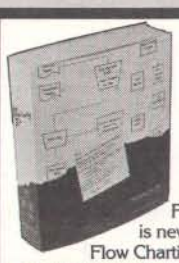


- **8052 Basic VI.I**
- **32 Kx8 Ram**
- **2 Real Time Clocks**
- **32 I/O Lines**
- **Programs Eproms**
- **Small 3.00x5.00 Size**

1-10 $179.00

Single Board Systems
P.O. Box 3788
Salem, Oregon 97302
Phone (503) 581-6570

Inquiry 277



Flow Charting II+
The New Plus for Fast Flowcharting

FLOW CHARTING is new! It's now Flow Charting II+, with more speed + more functions + more printing options;

• 10 text fonts; 26 shapes; • Line mode can stop at a shape; • Backspace key can erase a line to its origin; • Free text entry anywhere, or select auto-centering; • Vertical or horizontal printing; one chart or multiple charts.

Used by Fairchild, Bechtel and more than 500 other major corporations. Edit quickly and accurately — even major edits — with Flow Charting II+, the Specialist.

See your retail store or call:

PATTON & PATTON
Software Corporation
800/672-3470, ext. 897 California
800/538-8157, ext. 897 National
408/629-5044 International)

Inquiry 219

$79 HARD DISK CONT.



Computer Surplus Store

New Shugart Model 1610
5-¼" Hard Disk Controllers

Emulates:
- Xebec S1410 (1610-3)
- DTC 510 (1610-1)
- SCSI (1610-4)

Works with:
- Micromint COM 180, SB180
- Wavemat Bullet
- AMPRO All Boards
- Macintosh
- Apple IIe
- ACS 1000

Full 90 Day Guarantee

Manual & Schematic Only $8

Xebec S1410 HDC $95

IBM PC Controllers
- Adaptec 2010A $150
- Adaptec 2070 (RLL 2-7) $175

(Shipping & Handling $5.00)

222 Phelan Ave. ● San Jose, CA 95112
408-280-1740

Inquiry 72

S-100 "THE PC PEOPLE"

800-528-3138 Orders Only
602-991-7870 Customer Service

S-100 DIV./696 CORP.
14455 NORTH 79TH ST.
SCOTTSDALE AZ 85260
TELEX 9103806778 SONE HUND

PC COMPATIBLE SYSTEMS

BBC "BIG BLUE CLONE"
"FCC" APPROVED & ONE YEAR LIMITED WARRANTY

BASIC CONFIGURATION: 8 MHz 8088-2 CPU, 256K-640K RAM, 8 SLOTS, 150 WATT P/S, SLIDE CASE W/ SPKR, "AT-STYLE" KEYBOARD $329
MS-DOS 2.11 ..... $ 75
MS-DOS 3.2 ..... $ 95
GW/BASIC ..... $ 89
360K HH FUJITSU OR TEAC FLOPPY DRIVE ..... $ 89
FLOPPY DISK CONTROLLER-2 INT. & 2 EXT. ..... $ 30
MONOCHROME/GRAPHICS CARD W/ PTR ..... $ 68
COLOR/GRAPHICS CARD ..... $ 60
RS-232C SERIAL CARD ..... $ 25
SIX-PAK COMPATIBLE CARD W/ 0-384K RAM ..... $ 85
TATUNG EGA MONITOR & 256K EGA, HGC, CGA $695

TATUNG



TCS-7000 80286-10 MHz, 640K RAM, 1.2Mb FLPY DRV, 210W P/S, MS-DOS 3.2, DIAGNOSTICS **$1395**

TCS-7000/96 W/ 96 Mb 28mSEC H.D. DRIVE **$2595**

cordata

PC-400 512K, 2 FLPYS, 14" 640X400 MNTR ..... $ 939
PC-400/20 W/ 20 Mb H.D. DRV $1,249
ATD-8-Q 8 MHz 80286, 640K,S,P, 1.2 FLP $1,549
ATP-8-Q PORTABLE VERSION OF ATD-8-Q $1,629

UNISYS

PC/IT BASIC W/ 512K, 1.2 FLPY $1,795
PC/IT EXPANDED W/ 96 Mb 28mSEC HD DRV $2,895
MICRO/IT BASIC W/ 512K, 1.2 Mb FLPY $1,395
MICRO/IT EXTENDED W/ 20 Mb HARD DISK $1,995

WYSE

WYPC-286 10 MHz, 640K,S,P,CLOCK, ETC. $1,698
WYPC-286-85 W/ 96 Mb 28 mSEC HARD DISK $2,899

NETWORKING

CONSULTATION & INTEGRATION QUESTIONS??

CALL OUR EXPERT SALES & TECH STAFFS!!

ADVANCED NETWARE STARTER KITS & SERVERS... CALL

3-PLUS USER NETWORK SPECIAL

TATUNG TCS-7000/96 SERVER W/ 1 Mb RAM, 96 Mb (28 mSEC) HARD & 1.2 Mb FLPY DISKS, SERIAL & PARALLEL PORTS, MONO MONITOR.
CACO U400-400W UNINTERRUPTABLE POWER SUPPLY.
NOVELL ADV. NETWARE 286 SFT LEVEL-1 V2.0A
ARCNETT 4-PORT PASSIVE HUB.
4 ARCNET CARDS & CABLES UP TO 100 FT. EACH.
3 B.B.C. WORK STATIONS "FCC" APPROVED W/ 4.77/8 MHz 8088 CPU, 4-LAYER MOTHER BOARD, 640K RAM, MONO/GRAPHIC/PRT CTRL, & MONITOR, "AT-STYLE" KEYBOARD, 360Kb FLPY DRIVE,
TAPE BACK-UP 60 Mb EXTERNAL $8,995

ALLOY **PC-SLAVE/16** 1Mb, 8MHz V20 ..... $649
ATNX FOR MS-DOS 3.1 ..... $195

ARCNET COMPATIBLE 1/2 CARD $295
8-PORT ACTIVE HUB $449
4-PORT ACTIVE HUB PC/CARD $225
4-PORT PASSIVE HUB ..... $ 49

AST

6-PAK PREMIUM/256K WHILE THEY LAST! $189
RAMPAGE-AT $395
RAMvantage 512K-3Mb $259
ADVANTAGE $329
3G-PLUS 256K,HGC,CGA,EGA $335

intel

ABOVE BOARD/PC 1110 ..... $238
ABOVE BOARD/AT 2110 ..... $368
ABOVE BOARD/AT 2010 ..... $328
INBOARD 386/AT 0-1Mb RAM converts your existing PC/AT to a 16 MHz 80386 ..... $1,098
MATH **8087-2** ..$155 / **80287-8** ..$249

houston instrument

CALL FOR BEST PRICES – WE WON'T BE BEAT!!!

POWER SYSTEMS & ACCESSORIES

P-15 MONITOR BASE W/ 5 A/C PLUGS NOISE & SURGE & MODEM PROTECTED, DISK STORAGE ..... $ 89
U1000 POWER SAVER 1000W U.P.S. (by TOPAZ) W/ 4 OUTLETS & TRUE SINE WAVE ..... $ CALL
U400 POWER SAVER 400W ..... $ CALL

TRIPP LITE

BC-675 S.P.S. 70 MIN. 1/2 LOAD ..$569
BC-1000 S.P.S. 45 MIN. 1/2 LOAD $889

MONITORS & TERMINALS



$1695.00

TATUNG ONE YEAR WARRANTY & 30 DAY D.O.A. SWAP-OUT!

CM-1365 RGB 13" 5-COLOR TEXT QUANTITY 5 ..$319
CM-1380F EGA 13" 640X350 G/A SWITCH $439
TEGA-22 256K EGA 1/2 CARD HGC CGA MDA $239
MM-1222A AMB/GRN HI-RES MONO MONITOR ..$ 95

NEC MULTISYNC MONITOR ..... $ CALL

LINK

MC-3 AT-K.B. GRN/AMB/WHT SCREENS $399
PC-TERM AT-K.B. GRN/AMB SCREENS $369
220 DEC EMULATION $399

WYSE

WYSE 30 ..... $299
WYSE 50 ..... $309
WYSE 60 ..... $449

PRINTERS & BUFFERS

brother

HR-20 20 CPS DAISY WHEEL-AUTO LOAD ..... $ CALL
M-1109 100/25 CPS P & S W/ TRACTOR $189
M-1509 180/45 CPS P & S W/ TRACTOR $349
M-1709 240/50 CPS P & S W/ TRACTOR FX-286 & IBM PROPRINTER COMPATIBLE W/ "PAPER PARK" ALLOWS SIMULTANEOUS LOADING OF CONTINUOUS FORM & CUT SHEET PAPER & AUTO LOADS $449

CITIZEN

MSP-10 ..... $279 **MSP-15** $369
MSP-20 ..... $309 **MSP-25** $469
120D ..... $169 **PREMIERE 35** $459
CORDATA LP-300 LASER PRINTER $2,089
AST TURBOLASER (RICOH BASED) ..... $ CALL

STAR MICRONICS SR-15 (DEMO) $395
TOSHIBA ..... $ CALL
XEROX/DIABLO 635 W/ I/F $729
XEROX/DIABLO D80IF $1,295
XEROX 4045 LASER W/ COPIER & DRAM $3,995

Industrial Computer Designs

A/D 64-PC ..... $369 **D/A 64-PC** $439
1018-PC 128 TTL IN-PUT LINES $369
A/D 64-100 (S-100) ..$225 **D/A 64-100** (S-100) ..$298

SCIENTIFIC SOLUTIONS

IEEE 488 ..... $239
IEEE 488 SOFTWARE ..... $ 65
E + EEPROM PROGRAMMER/READER $275
LAB MASTER $859

S-100 BUS PRODUCTS

CPRO RAM-16 64K STATIC ..... $ 99
BRACKETS FOR COMPUPRO DRIVE CABINET ..$ 25
COMPUPRO SYSTEM 816/C3-40 Mb $7,449
INTERCONTINENTAL MICRO SYSTEMS ..... $CALL

DRIVES

26 Mb PC-INSIDER ..... $ 389
38 Mb PC-INSIDER ..... $ 498
51 Mb PC-INSIDER ..... $ 829
51 Mb AT-INSIDER ..... $ 749
96 Mb AT-INSIDER $1,179
SMS SIGEN i60 INTERNAL 60 Mb TAPE SYSTEM ..$ 695
IRWIN 20 Mb TAPE INTERNAL ..... $ 469
TECMAR QIC 60/AT INT 60 Mb TAPE $1,095
SEAGATE ST-225 HH ..... $ 309
SEAGATE ST-4051 FH ..... $ 775
QUANTUM Q540 43 Mb FH ..... $ 749
MICROPOLIS 1325 85 Mb 28 mSEC $1,198
MAXTOR XT-1140 140 Mb 28 mSEC $2,595
MAXTOR XT-2190 190 Mb 28 mSEC $2,995
MITSUBISHI 2894 FH 8" ..$465 / **2896** HH 8" ..$ 425
MITSUBISHI MF-501 48 TPI ..$95 / **MF-504** 96 TPI ..$ 129
TEAC FD-55-BV 48 TPI FLPY DRV ..... $ 89
FUJITSU 5.25" HH 48 TPI FLPY DRV ..... $ 89

DISKETTES & TAPES

100 LOT CASE PRICES/EACH

DYSAN 48 TPI DSDD ..... $1.87 / 96 TPI ..... $ 2.11
DYSAN 96 TPI DSHD-AT ..... $ 2.25
DYSAN "DC-600 TYPE" 600' TAPE $22.99
3M DC-2000 20 Mb TAPE FOR "IRWIN" $20.49

SOFTWARE

WE SELL ALL WELL KNOWN BRANDS! ORDER CORRECTLY! OPENED SOFTWARE IS NOT RETURNABLE!

NEWSTAR NEW-WORD 3 WORDSTAR COMPATIBLE $189
BD SOFTWARE "C" COMPILER ..... $ 95
MICROSOFT WORD/PC $280
ASHTON-TATE dBASE III PLUS $461
MICRORIM rBASE SYSTEM V $418
XEROX VENTURA DESKTOP PUBLISHER $595

MODEMS

ProMODEM 1200B W/ MIRROR SOFTWARE ..$125
ProModem 1200 ...$249 **ProModem 1200G** ..$169

CTS 2424 ADH ASYNCH/SYNCH (HAYES) ..$269
CTS 2424 AMH CLASS 4 MNP ERROR CORRECT ..$349

MT224EH MNP ERROR CORRECTION $395
MT224ER RACK MOUNT W/ ERROR CORR ..$379

U.S. ROBOTICS COURIER 2400 ..... $335
U.S. ROBOTICS 212A "HAYES COMPATIBLE" ..$195

All merchandise new. Advertised prices are cash prepaid only. PO's from qualified firms & AM. Express ☐ 95 MC & Visa ☐ 968. COD's (☐ 99, $5 min. fee) with Cashiers Check/MO. Bank Wires & APO's accepted. Shipping: minimum $4 first 5lbs. Tax: AZ RES. ONLY add 6.5% sales tax. All returns subject to 20% restocking fee or credit towards future purchases. All prices & availability subject to change without notice.

S-100 ESTABLISHED 1977

TOSHIBA
Lap Top T1100/T3100
5¼" External Disk



- Runs 5¼" PC Disks; Programs On Your Toshiba LAP TOP
- 360 KB Floppy Diskette Drive
- Includes Cable & Power Supply

MEGA ENGINEERING
18557 Parthenia St.
Northridge, CA
(818) 712-0582

Inquiry 156

TURBO 10MHz 1MB AT/XT



OPEN 7 DAYS

TURBO AT $1,400 — **$1,950/w SEAGATE — 4038 30MB**
HI-RES SWIVEL-BASED AMBER MONITOR • INTEL 80286-6/10 MHz • ONE MB 120NS RAM ON BOARD • PHOENIX 2.0 BIOS • HERCULES EMULATION GRAPHICS CARD /w PARALLEL SERIAL PORTS • OPERATES MS-DOS, PS-DOS, XENIX, UNIX, GW BASIC • 8 SLOTS • WD CONTROLLER 2FD/2HD • ENHANCED KEYBOARD/w LEDS • 200 WATTS POWER • 1.2 MB TEAC FLOPPY • ON BOARD CLOCK/CALENDAR • HARDWARE RESET • 80287 SOCKET • OPTIONAL EGA OR COLOR • OPTIONAL '0' WAIT STATE OR 12 MHz • FULLY SET UP/TESTED • MANUALS • ONE YEAR PARTS/LABOR

TURBO XT $750 — **$1100/w SEAGATE 20 MB & ONE FLOPPY**
HI-RES AMBER MONITOR • INTEL 8088-2 OR NEC V-20 RUNNING 10MHz 330% FASTER THAN IBM PC • 640K ON BOARD • FULLY COMPATIBLE BIOS • HERCULES EMULATION GRAPHICS CARD /w PARALLEL PORT • OPERATES MS-DOS, PC-DOS, GW BASIC • 8 SLOTS • DISK I/O CARD: 2 FD CONTROLLER, 2 SERIAL, 2ND OPT'L PARALLEL, GAME, CLOCK/CALENDAR, BATTERY, RAM DISK, PSPOOL • AT KEYBOARD/w LEDS • 150 WTS • TWO 360K FUJITSU DRIVES • 8087 SOCKET • MANUALS • FULLY SET-UP/TESTED • ONE YEAR PARTS/LABOR •

PORTABLE XT/AT SYSTEMS ALSO AVAILABLE

PCPRO SYSTEMS. INC.
800-451-5279

43 WEST 33RD ST., 2ND FL.,
NEW YORK, NEW YORK 10001
(212) 239 0625

9832 E. FLOWER ST.
BELL FLOWER, CA 90706
(213) 923-5052

Inquiry 224

EVSAN
P.O.Box 2143
Daly City, CA 94017

Order Toll Free:
(800) 443 - 8853
Tel.(415) 991 - 1051

V - 20	8mhz	9.00	V - 30	8mhz	11.00

Math Co Processors

C8087	8mhz	142.00	80287	8mhz	275.00
C8087	5mhz	102.00	80287	6mhz	168.00

DYNAMIC RAMS			EPROMS		
1 MEG	150/100ns	36.00	27512	250ns	15.00
41256	100ns	4.50	27256	250ns	5.10
41256	120ns	2.85	27C256	200ns	6.90
41256	150ns	2.50	27C256	250ns	6.40
4464	120ns	4.25	27128	150ns	4.50
4464	150ns	3.78	27128	250ns	3.60
4128	150ns	3.95	2764	200ns	3.60
4164	120ns	1.20	2764	250ns	3.10
4164	150ns	0.98	2564	450ns	7.50
COLOR GRAPHIC CONTROLLER			2532	450ns	4.25
			2716	450ns	2.95
D7220AD		18.50	2708	450ns	2.25

STATIC RAMS					
43256L	120ns	22.50	6264L	150ns	2.85
5565PL	150ns	3.25	5564PL	150ns	5.25
6116L	150ns	1.60	6116P	150ns	1.40
4016	150ns	1.40	2016P	100ns	1.50

FLOPPY DISK DRIVE :	TEAC 5¼	FD55B	94.00
	FUJITSU 5¼	M2551	82.00
INTERFACE:			
1488	0.32	1489	0.32

TERMS AND CONDITIONS: PRIME PARTS 100% GUARANTEED
1) Prices subject to change, PLEASE CALL for CURRENT & VOLUME PRICING. MINIMUM ORDER $10.00
2) SHIPPING & HANDLING UPS GROUND ..... $ 3.00
ONE POUND CHARGES UPS 2nd DAY ..... $ 4.50
California Resident subject to sales tax.
3) 3% SURCHARGE ON CREDIT CARD CHARGES
OFFICE HOURS: MON to FRI 7:30AM to 5:30 PM

Inquiry 106

BATTERY BACK-UP UNIT
COMPATIBLE KEYBOARDS

Unique new high efficiency design for 250 & 400 watt Battery Back-up(UPS=Uninterruptible Power Supply).Runs full system for 10-45 min. to allow file back-up. UPS-250 can run as AC power supply on car/boat with 12V I/P. UPS-400, same for 24 V I/P. Highly reliable and cost effective units.
Dealer prices available for quantity buyers.
UPS-250..$239.95 UPS-400...$379.95

- * Panasonic drives 3.5", 5.25", 360K,720K,1.2M,
- * Bare IBM PCB's
- * XT-AT Proto boards
- * XT-AT Extender "
- * XT-AT Fliptop Case
- * XT-AT Keyboard
- * XT-AT Pwr Supplys
- * Bench switchers
- * EPROM PRGRMR
- * Apple bare PCB's
- * Isolation Xformers
- * Stepup/down Xfrmr
- * ATTAK-286, 4Layer 10-12M Turbo AT
- * 10M-4Layer Turbo 2 Bios XT clone

* Very fast XT, 4 layer 8-10 Mhz, Dual Bios,

* XT Turbo kits

From $249/Min syst to $599 Complete Syst
We have hundreds of interesting items for the hobbyist in IBM or Apple compatibles. Pls circle our response number to get our flyer to you.

COMPUTER PARTS GALORE INC.
56 HARVESTER AVE., BATAVIA NY 14020
TOLL FREE 800-431-9008,NY 716-343-6133

Inquiry 372

IBM Turbo Users Shout: "SENSATIONAL..."



TURBOsmith®
For Turbo Pascal

Feature-PACKED, Source Debugging Power with Multi-Window Variable View & Machine Code Readouts

Animates code with Visible Ease!

ORDER - 800 732-2345
(In Calif.) 213 534-4202

VISUAL AGE
★ 642 N. Larchmont Blvd
Los Angeles, CA 90004 ★

30 Day M.B.G. $69

Inquiry 371

SAME-DAY SHIPMENT!
MONEY-BACK GUARANTEE!

"RS-232C TO CURRENT LOOP BI-DIRECTIONAL CONVERTER" Model 232CL2
only **$89.95**



Interface your RS-232 port to existing current loop system. Model 232CL2 couples and isolates Transmit and Receive Data through high speed optical isolators. Powered from pins 4, 5, 6, 8 and 20 on the RS-232 side; one pin must be high, one must be low.

No power required if current loop port is active. Model 232PS-12V DC Power Supply required if current loop port is passive; only $14.95.

Order direct from manufacturer *TODAY* and *SAVE!**

Request your FREE copy of B & B ELECTRONICS' Catalog which lists a host of interface and monitoring equipment for RS-232 ports.



*Terms: Visa, MC, cash orders postpaid; P.O.'s from qualified rated firms accepted. IL residents add 6¼% sales tax.

B&B electronics MANUFACTURING COMPANY

1502C Boyce Memorial Drive • P.O. Box 1008 • Ottawa, IL 61350
Phone: 815-434-0846

Inquiry 35

LOWEST PRICES

XT/AT	SYSTEM	$395/$749
20/30 MB	DRIVE KIT	$339/$389
4038/4051	SEAGATE	$579/$679
360K/1.2M	FLOPPY DRIVE	$ 79/$119
1200/2400	EVEREX MODEM	$ 99/$199
1200/1200HC	AVTEX MODEM	$ 89/$129
TTL/RGB	MONITOR	$ 89/$269
EGA/NEC	MULTISYNC	$429/$549
TTL/EGA	CARD	$ 69/$199
LV1210/NX10	STAR	$179/$209
FX86/FX286	EPSON	$229/$489
182/292	OKIDATA	$219/$489
5/8MHZ	8087	$ 99/$139
6/8/10MHZ	80287	$159/$239

COMPUTER MART
CALL FOR ITEMS NOT LISTED

9415 BURNET ROAD, SUITE #110
AUSTIN, TEXAS 78758

800-225-0105 ★ 512-836-3766

Inquiry 370

Printer (Data) Switch $39/up
Dealer Price available



- •Metal case
- •Fully shielded
- •Push button (2 layer PC board or rotary switch)
- •Beige color
- •1 year warranty

CABLE (Lifetime warranty) $9/up

- UL approved, molded, double shielded, beige color
- D type connector with thumb screw (screwless)

Switch box		Cable	
2 way switch	$39/$45	Printer cable 6'/9'/12'	$9/$12/$15
2 way cross	$55/$69		
4 way switch	$55/$69	Modem cable 3'/6'	$7/$9
Power center/DB 25		Centronic cable 6'/10'	$12/$15
switch/swivel base	$89		

Serial cable, Drive cable & extension cable available

RS232 Miniature $6/up
RS232 Break-out box $59

JACO Computer Products
Tel: (408) 746-2000

989 E. California Ave.
Sunnyvale, CA 94086

Inquiry 148



CHAS
MICROSYSTEMS, INC.
P.O. Box 707
Wayne, NJ 07470
(201) 227-1565
TELEX 6503141175

• • • 100% IBM COMPATIBLE • • •

PC/XT TURBO computer

•4. 77/8 MHz •640k •'AT' style keyboard •2 360k disk drives •Parallel •Serial •Game •Clock & Calendar w/battery back-up •Mono graphics card •Green or Amber monitor •1 YEAR WARRANTY **$899.00** (**$1175.00** with 20meg hard disk drive and 1 floppy)

AT TURBO computer

•6/8 MHz •640k •Enhanced keyboard •1.2meg floppy disk drive •Parallel •Clock & Calendar w/battery back-up •Mono graphics card •Green or Amber monochrome monitor •1 YEAR WARRANTY **$1425.00** (**$1900.00** with 30meg hi-speed hard disk drive)

**** COLOR SYSTEMS ALSO AVAILABLE ****
**** PORTABLE XT COMPUTERS AVAILABLE ****

•Floppy drives start at $85 •Hard drives w/controller start at $370 •Hayes compatible modems start at $125 •Printers start at $215
WE CARRY THE IBM XT, THE IBM AT, AND THE COMPAQ 386
WE CARRY PC DOS 3.2!
WE CAN CUSTOM CONFIGURE ANY IBM COMPATIBLE SYSTEM!
CALL FOR FREE PRICE LIST! DEALER INQUIRIES WELCOMED!
(prices subject to change without notice)

Inquiry 373

FORTRON CORPORATION
3225 Seldon Court
Fremont, CA 94538

Information & CA Res. (415) 490-8171
Technical Support (415) 490-8403
Orders Only (800) 821-9771

FORTRON PRESENTS THE DEPENDABLE ONES

While some power supply importers reduce their selling prices by using cheaper and fewer materials, we at Fortron do not jeopardize our discriminating customer's faith in our standards of quality by such compromises.

Here are some visible differences Fortron uses:

- **Burndy (U.S. made) connectors** which provide error-free connections from power supply to CPU board and peripherals.
- **A shielded power cord** insures minimum AC line interference.
- **Built-in EMI filter** maintains a conductive emissions level specification to greater than 6 dB/uV below **FCC Class B.**
- **All U.L. recognized materials and circuit layout** to ensure complete safety.

In addition to our high quality materials, our testing facility in the U.S. and our technical support from five full time power supply and system application engineers has made Fortron's PC/XT and AT power supplies tops in their field.



E 101115 S
LR 58720-8M

200 WATT PC AT

- U.L. recognized, certified
- OVP, OCP, short circuit protection
- Meets European safety requirements
- MTBF 34,000 hours
- Four drive connectors
- One full year warranty



150 WATT PC XT
Direct Replacement for IBM® PC XT Power Supply

REVOLUTIONARY PRICED

Hercules© compatible Monochrome Graphics/Controller

-Compatibility-
For PC, XT, AT. 6, 8, 10, 12 Mhz.
- IBM© Monochrome/Printer adapter compatible
- Hercules© Graphics Adapter compatible
- Runs directly Lotus© 1-2-3 AutoCad©, Symphone©, Basic

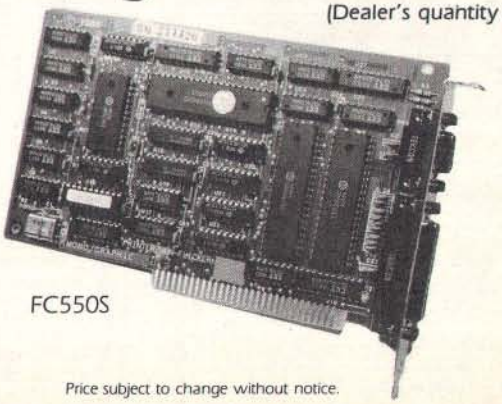
-Outstanding Features-
- 80 X 25 text mode
- 64K bytes graphics display memory
- 720 X 348 pixel resolution
- Printer interface

-Short Card, easy installation-

-Reliability-
- Custom-built chip, ICT tested, producing a nearly zero defect rate.
- lower signal to noise ratio
- one full year warranty

-FCC Class B Certified-

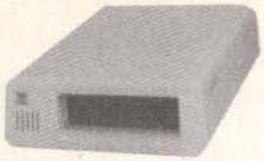
starting at . . . 43.00 ea.
(Dealer's quantity price)



FC550S

Price subject to change without notice.

ENCLOSURE POWER



* Floppy's, Hard Disk, Optical Disk, Tape Drive, or any Combination
* Custom Design with Injection Molding Front
* Superb Quality and Pricing
* Prompt Delivery

JMR ELECTRONICS, INC.
The Power Source Behind The Drive
18559½ Parthenia Street, Northridge, California 91324
Outside CA (800) 635-5555
CA (818) 993-4801

Inquiry 155

Why waste time?

ACCELERATE with VCACHE™

HARD DISK ACCELERATOR
• Caching eliminates repetitive disk accesses
• Use up to 15 Mb of extended/ expanded or 500 Kb of standard memory

DISKETTE ACCELERATOR
SCREEN ACCELERATOR
FAST — FRIENDLY — SAFE
VCACHE
GOLDEN BOW SYSTEMS

$65
Add $3 for shipping/handling
California residents add 6% sales tax



2870 Fifth Avenue
Suite 201
San Diego, CA 92103
619/298-9349

Inquiry 124



Sure it's insured?

SAFEWARE® Insurance provides full replacement of hardware, media and purchased software. As little as $39/yr. covers:
• Fire • Theft • Power Surges
• Earthquake • Water Damage • Auto Accident

For information or immediate coverage call:
1-800-848-3469
In Ohio call 1-614-262-0559

SAFEWARE
SAFEWARE, *The Insurance Agency Inc.*

Inquiry 267

NEW

REAL WORLD I/O
Affordable Access To The Real World For PC/XT/ATs

AD500 • 8-channel, 12-bit analog input board. Software programmable gains of 1,10,100. Utilizes a highly stable A/D converter. Excellent accuracy and high noise immunity. 7 digital I/O lines. Ideal for lab/industrial automation. **$239**

AD100 • Single channel version of AD500 with 10 digital I/O lines. Same programmable gain and high noise immunity. Useful for transducers, ATE, education. **$149**

DG24 • Digital I/O board with 24 TTL I/O lines configurable in software. 8255 PPI based. **$95**

XB40 • Extender board and cable for above boards. Includes easy connect terminal strip and prototype area. **$49**

Software examples in Pascal, BASIC, Forth and Assembly.
Complete documentation and money back guarantee.

Real Time Devices, Inc.
std
1930 PARK FOREST AVENUE
P.O. BOX 906
STATE COLLEGE, PENNSYLVANIA 16804
(814) 234-8087

Inquiry 258

ICs PROMPT DELIVERY!!!
SAME DAY SHIPPING (USUALLY)
QUANTITY ONE PRICES SHOWN for JAN. 25, 1987

OUTSIDE OKLAHOMA: NO SALES TAX

640 Kbyte MOTHERBOARD KITS: Zenith 150, IBM PC/XT, Compaq Portable & Plus; hp Vectra

DYNAMIC RAM			
1Mbit	1000Kx1	100 ns	$33.00
51258	*256Kx1	100 ns	8.50
4464	64Kx4	150 ns	3.29
41256	256Kx1	100 ns	3.84
41256	256Kx1	120 ns	2.69
41256	256Kx1	150 ns	2.49
4164	64Kx1	150 ns	1.30
EPROM			
27512	64Kx8	200 ns	$11.25
27C256	32Kx8	250 ns	5.15
27256	32Kx8	250 ns	4.96
27128	16Kx8	250 ns	3.77
27C64	8Kx8	150 ns	4.85
2764	8Kx8	250 ns	3.25
STATIC RAM			
62256	32Kx8	120 ns	$14.95
6264LP-15	8Kx8	150 ns	2.85

* STATIC COLUMN DRAM FOR 386 COMPAQ

$120.00 5 Mhz
$270.00 8Mhz
8087 - 80287-8

OPEN 6½ DAYS, 7 AM-10 PM: SHIP VIA FED-EX ON SAT.
SUNDAYS & HOLIDAYS: SHIPMENT OR DELIVERY VIA U.S. EXPRESS MAIL

SAT DELIVERY INCLUDED ON FED-EX ORDERS RECEIVED BY:
Th: Std Air $6.4 lbs
Fr: P-One $13.2 lbs

MasterCard/VISA or UPS CASH COD
Factory New, Prime Parts μP∞
MICROPROCESSORS UNLIMITED, INC.
24,000 S. Peoria Ave.,
BEGGS, OK. 74421
(918) 267-4961
No minimum order

Please call for current prices because prices are subject to change. Shipping & insurance extra $1.00 for packing materials. Orders received by 5 PM CST can usually be delivered the next morning, via Federal Express Standard Air @ $6.00, or Priority One @ $13.00!

Inquiry 191

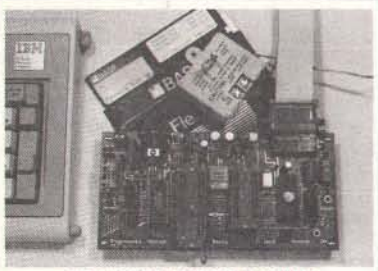
When MEDIA CONVERSION Fails, DATA TRANSLATION Prevails!

Use your data among mainframes, minis, micros, dedicated word processors, and typesetters!
We offer translation of the logical elements of data in addition to conversion of physical parameters, NOT just dumping or ASCII transfer from one medium into another. For example:

- Translation of the control characters and formatting features of stand-alone or microcomputer-based **word processors.**
- **Database** restructuring—Even from your word processors' File and List Managers.
- **Spreadsheet** translations—formatting, cell referencing codes, and formulas.
- **State and federal** compliances—Magnetic media and file-structure conversions.

ADAPSO member
CompuData Translators, Inc. 6565 Sunset Blvd. Suite 301, Hollywood, CA 90028 **(213) 462-6222**

Inquiry 64



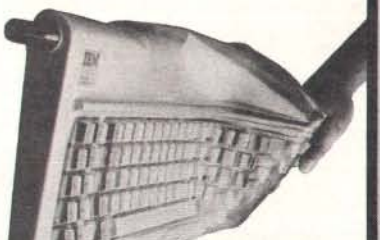
6805/6305 SINGLE CHIP MICROCOMPUTER DEVELOPMENT SYSTEMS

Two systems allow the IBM PC/XT/AT to be used as a complete development system for the **MOTOROLA** 6805 series single chip microcomputers. Model MCPM-1 supports the MC68705P3, P5, U3, U5, R3, & R5 chips. Model MCPM-2 supports the MC1468705F2 & G2 cmos versions. Both systems are priced at $495 and include a cross assembler program, a Simulator/Debugger program and a programming circuit board with driver software. A system is also avail. for the **HITACHI 63705 ZTAT** micro.

THE ENGINEERS COLLABORATIVE
P.O. Box 53, West Glover, VT 05875
(802) 525-3458

Inquiry 301

NEW!



SafeSkin™
KEYBOARD PROTECTOR

Remains in place during keyboard use. Prevents damage from liquid spills, dust, ashes, etc. Fits like a second skin, excellent feel. Available for: IBM-PC, AT, Apple (all), Compaq, Model 100, NEC 8201, C64, Zenith 150, DEC, Kaypro, KB5151, AT&T 6300, WYSE 50 and many others, Send $29.95, check, M.O., Visa & MC include exp. date. Specify computer type. Dealer inquiries invited. Free brochure avail.

Merritt Computer Products, Inc.
4561 S. Westmoreland, Dallas, Texas 75237
(214) 339-0753

Inquiry 186

Motion Control & Data Acquisition



on your IBM PC or Apple II and all compatibles

Smart 2 Axis Motion Controller: For many types of motors & encoders. New I.C. (from HP) allows changes & monitoring on the fly. Optically isolated. W/SOFTWARE $350.
Four Axis Stepper Driver: With SOFTWARE & motor for instant automation. $95.
Fast A/D Board: With programmed gain, 650 KHz, 4 inputs, $220. Complete Scope hardware & SOFTWARE $500. **Also:** 12 Bit A/D, Relay Driver, Real Time Clock. Circuit developers Project Book $25.

How do you do it? Use our Local Applications Bus, **LAB 40.** One host adapter ($150) supports up to 8 boards, like those above, on a 50 ft. ribbon cable.

Please call (415) 755-1978 for free literature.

computer continuum
75 Southgate Ave., Suite 6
Daly City, CA 94015 (415) 755-1978

Inquiry 69

California Digital

17700 Figueroa Street ● Carson, California 90248



FOUR PEN COLOR PLOTTER $159

The manufacturer has asked us not to publish their name. But this four color plotter was produced by one of the Worlds largest makers of personal computers.
The 410 color plotter will connect to the **serial port** of virtually any micro-computer. Simple ASCII commands direct one of the four color pens to draw circles, arcs or ellipses on paper or transparency material up to 11 by 17 inches. The plotter is capable of producing the full upper and lower case alphabet along with seven international character sets. Text can be printed horizotal, vertical or diagonal in sizes from 1/16 to 6 inches, slanted forward or backward to 85 degrees.
Enlargements or reductions are achieved through elaborate firmware. Pen travel is four inches per second with .004" pen resolution. Standard pens are available in an assortment of 32 different colors and widths.
The ideal plotter for architecture, CAD engineering or graphic design. **At $595 it was a great buy, at $159 its a steal.** Support packages for specific computers available. Manual only $15 refundable upon purchase of plotter.

OTHER PLOTTERS AVAILABLE:
Hewlett Packard ● HoustonInstruments ● Roland
Sweet P ● CalComp... please call for prices.

Qume 142 PC Compatible

$65 **Quantity Two**



These Qume double sided PC compatible drives bear the IBM logo. The drive was manufactured for IBM for use in the recently discontinued PC Junior computer. We have purchased a large quantity of these drives and are currently offering them in sets of two for only $65 each.

Panasonic AT Compatible



$115

The Panasonic 475 is jumper selectable between 96 TPI format and 1.2 Megabyte as used in the IBM/AT computer.
Suggested price of this drive is $189 but because of unusual buying opportunity, California Digital is able to offer these drives at only $115 each, quantity two.

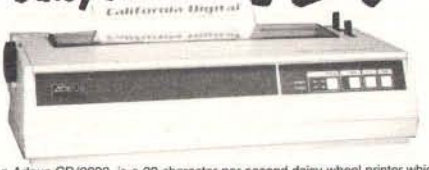
	One	Two	Ten
QUME 142 half height	69	65	call
TEAC FD55BV half height	109	99	89
TEAC FD55FV 96 TPI, half ht.	119	109	105
TEAC FD55GF for IBM AT	169	159	155
PANASONIC 455 Half Height	109	99	89
PANASONIC 475 1.2 Meg./96	119	115	109
MITSUBISHI new 501 half ht.	129	119	109
MITSUBISHI 504A AT comp.	169	159	155
Switching power supply			49
Installation Kit with manual			10
Dual enclosure for 5¼" drives			59
34 pin edge connectors			5
Scotch head cleaning kit			19
Flip & File Storage tubs			15

SONY $139



The Sony 53W is a 3½ inch double sided double density disk drive. The drive can be connected to your existing floppy controller but will require MS/DOS 3.2 to properly operate in the PC and compatibles. The 53W is similar to the drive being used in the PC portable.

Adeus Daisy Wheel $159



The Adeus CP/2000, is a 22 character per second daisy wheel printer which accepts 96 character Diablo wheels and ribbons. This printer was manufactured by the Olympia Typewritter Company for CosmoWorld USA.
This unit will print 10, 12 and 15 characters per inch proportionally spaced with increments of 1/120". Bi-directional printing, 2 K/Byte buffer, and Centronics parallel interface make the Adeus CP/2000 an exceptional buy at only $159.
Original price $595. RS232 serial interface $30.00 additional.

Bernoulli Box

was $3540 now only

$1595



The **Bernoulli Box** by Iomega, features 10 and 20 megabyte removable cartridges, and delivers reliability, expandability, transportability, security and speed in one versatile subsystem. It lets you transfer megabytes of information safely and swiftly for primary or backup storage. Or combine several software programs onto a single cartridge for easy switching from one to another.
Reliable... the Box has incredible resistance to shock and vibration completely eliminating the possility of head crash.
Expandable... grow at your own pace by adding inexpensive cartridges. When **security** is essential, don't lock up your system... just lock up the cartridges.
The Bernoulli Box delivers preformance that often exceeds the best of hard disk speed and the convenience of floppy disks. At these prices don't be caught wishing you had one after a loss of irreplacable data.

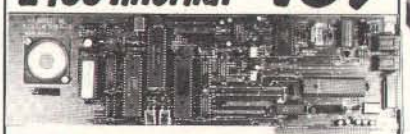
		List	Our Price
10+10 Meg.	**A2210H**	**$3450**	**1595**
20+20 Meg.	**A2220H**	**4540**	**2095**
Bootable Controller		**255**	**189**
10 Meg. Cartridge		**79**	**49**
20 Meg. Cartridge		**99**	**65**

Smarteam 2400 Baud $289



The Smarteam 2400 offers all the features of the Hayes Smart Modem 2400 for a fraction of the price. Now is your opportunity to purchase a 2400 baud modem for only $289.
Also available: The Smarteam 1200 at only $159

U.S. Robotics 2400 Internal $189



The US Robotics 2400 modem is one hundred percent Hayes compatible, auto dial, auto answer, auto everthing. A super value at only $189.



$99

This 300/1200 baud modem matches design specs of Bell 212A and for all practical purpose those of the Hayes Smart Modem. The Avatex brings you reliable data transmission for only $99.

OTHER MODEMS AVAILABLE:
Hayes ● Universal Data ● Fujitsu
Prometheus ● Anchor ● US Robotics

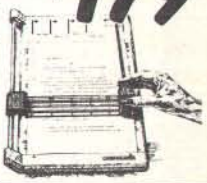
NOW YOUR COMPUTER CAN READ!!

Omni-Reader... the first optical character reader **designed and priced for the small computer**

$179

COPY:
•Manuscripts •Contracts •Articles
•Forms •Invoices
APPLICATIONS:
•Mailing Lists •Editing •Data Base Management •Transfering information between incompatible systems

Uses a standard RS-232 serial port hookup to interface eaisily with your computer.





IBM Thermal Printer $59.95

Manufactured by IBM for use with the PC series printers. This 80 column "super quiet" thermal printer is ideal for fast low cost drafts. The printer is capable of interfacing to any computer with an 1200 baud RS-232 serial port. Accepts either fan fold or 8½" roll fed thermal paper. Will "NOT" accept writing paper. Nine pin head allow the IBM thermal printer to output extended foreign character set, math symbols and bit image graphics. At $59.95 we expect quick sell out.

21 Megabyte Gold Card



$479

Also available 31 Megabytes at only $559.

The fastest, lowest powered, longest warrantied, most durable, highest capacity, most reliable, lowest priced HARD-DISK-ON-A CARD available in the world today.

• 65ms Access Time • *Fastest Available* • Automatic Head Unloading • *Protects Heads and Media* • 2K Sector Buffer • Increases System Throughput • High Reliability: 28,000 hr. MTBF *No one else even close* • 15.5 Watt Power Consumption • *Lowest Available* • 2 Year Warranty *Longest Available*

Seagate 30 MEGABYTE WINCHESTER HARD DISK KIT $459



Five Inch Winchester Disk Drives

	each	two+
SEAGATE 225 20 Meg. ½ Ht.	329	299
SEAGATE 238 30 Meg. RLL	389	359
SEAGATE 4026 26 M. 35mS.	659	629
SEAGATE 4051 51 M. 35mS.	795	759
FUJITSU 2242 55 M. 35mS.	1399	1329
FUJITSU 2243 86 M. 35mS.	1895	1819
RODIME RO-202E 27 Meg.	659	629
RODIME RO-203E 40 Meg.	995	959
RODIME RO-204E 53 Meg.	995	959
CONTROL DATA 94155-86 M.	1829	1779
MAXTOR XT1140 140 Meg.	2595	2529
TOSHIBA MK56 70 M. 30mS.	1789	1729
TANDON 502 10 Meg.	419	379

● Winchester Controllers for IBM/PC ●	
XEBEC 1220 with floppy controller	229
DTC 5150CX	139
OMTI 5520 half card	129
OMTI 5527 RLL controller	159
ADAPTEC 2070 RLL controller	179
ADAPTEC 2010A	159
WESTERN DIGITAL WD/1002WX2	119
● SCSI/SASI Winchester Controllers ●	
XEBEC 1410A 5¼" foot print	219
WESTERN DIGITAL 1002-05E 5¼"	289
OMTI 20L	119
● Winchester Accessories ●	
Installation Kit with manual	10
Winchester enclosure and supply	139
Dual 20/34 cable set	25
Switching power supply	49

VISA

master charge

Shipping: First five pounds $3.00, each additional pound $.50.
Foreign orders: 10% shipping, excess will be refunded.
California residents add 6½% sales tax. ● COD's discouraged.
Open accounts extended to state supported educational institutions and companies with a strong "Dun & Bradstreet" rating.

TOLL FREE ORDER LINE
(800) 421-5041
TECHNICAL & CALIFORNIA
(213) 217-0500

Mail Order Electronics · Worldwide

Jameco ELECTRONICS

Mail-Order Electronics 415-592-8097

7400

Part No.	1-9	10+	Part No.	1-9	10+
7400	.29	.19	7485	.65	.55
7402	.29	.19	7486	.45	.35
7404	.35	.25	7489	2.05	1.95
7405	.39	.29	7490	.49	.39
7406	.39	.29	7493	.45	.35
7407	.39	.29	74121	.45	.35
7408	.35	.25	74123	.59	.49
7410	.35	.25	74125	.55	.45
7414	.49	.39	74126	.75	.65
7416	.45	.35	74143	4.05	3.95
7417	.45	.35	74150	1.35	1.25
7420	.35	.25	74154	1.35	1.25
7430	.35	.25	74158	1.59	1.49
7432	.39	.29	74173	.85	.75
7438	.39	.29	74174	.65	.55
7442	.55	.45	74175	.65	.55
7445	.79	.69	74176	.99	.89
7446	.89	.79	74181	1.95	1.85
7447	.89	.79	74189	2.05	1.95
7448	2.05	1.95	74193	.79	.69
7472	.75	.65	74198	1.85	1.75
7473	.45	.35	74221	.99	.89
7474	.45	.35	74273	2.05	1.95
7475	.49	.39	74365	.69	.59
7476	.45	.35	74367	.69	.59

74LS

74LS00	.29	.19	74LS165	.75	.65
74LS02	.29	.19	74LS166	.99	.89
74LS04	.35	.25	74LS173	.59	.49
74LS05	.35	.25	74LS174	.49	.39
74LS06	1.09	.99	74LS175	.49	.39
74LS07	1.09	.99	74LS189	4.59	4.49
74LS08	.29	.19	74LS191	.59	.49
74LS10	.29	.19	74LS193	.79	.69
74LS14	.49	.39	74LS221	.69	.59
74LS27	.35	.25	74LS240	.79	.69
74LS30	.29	.19	74LS243	.79	.69
74LS32	.35	.25	74LS244	.79	.69
74LS42	.49	.39	74LS245	.89	.79
74LS47	.99	.89	74LS259	.99	.89
74LS73	.39	.29	74LS273	.89	.79
74LS74	.35	.25	74LS279	.49	.39
74LS75	.39	.29	74LS322	4.05	3.95
74LS76	.55	.45	74LS365	.49	.39
74LS85	.59	.49	74LS366	.49	.39
74LS86	.35	.25	74LS367	.49	.39
74LS90	.49	.39	74LS368	.49	.39
74LS93	.49	.39	74LS373	.79	.69
74LS123	.59	.49	74LS374	.79	.69
74LS125	.49	.39	74LS393	.89	.79
74LS138	.49	.39	74LS590	6.05	5.95
74LS139	.49	.39	74LS624	2.05	1.95
74LS154	1.09	.99	74LS629	2.29	2.19
74LS157	.45	.35	74LS640	1.09	.99
74LS158	.45	.35	74LS645	1.09	.99
74LS163	.59	.49	74LS670	1.09	.99
74LS164	.59	.49	74LS688	2.05	1.95

74S/PROMS*

74S00	.29	74S188*	1.29
74S04	.35	74S189	1.69
74S08	.35	74S196	2.49
74S10	.29	74S240	1.49
74S32	.35	74S244	1.49
74S74	.45	74S253	.79
74S85	1.79	74S287*	1.49
74S86	.35	74S288*	1.49
74S124	2.95	74S373	1.49
74S174	.79	74S374	1.49
74S175	.79	74S472*	2.95

74ALS

74ALS00	.35	74ALS138	.89
74ALS02	.35	74ALS174	.89
74ALS04	.39	74ALS175	.89
74ALS08	.39	74ALS240	1.49
74ALS10	.39	74ALS244	1.49
74ALS27	.39	74ALS245	1.49
74ALS30	.39	74ALS373	1.69
74ALS32	.39	74ALS374	1.69
74ALS74	.49	74ALS573	1.69

74F

74F00	.39	74F139	.89
74F04	.39	74F157	.95
74F08	.39	74F193	3.95
74F10	.39	74F240	1.39
74F32	.39	74F244	1.39
74F74	.49	74F253	.99
74F86	.59	74F373	1.39
74F138	.89	74F374	1.39

CD—CMOS

CD4001	.19	CD4076	.65
CD4008	.89	CD4081	.25
CD4011	.19	CD4082	.25
CD4013	.29	CD4093	.35
CD4016	.29	CD4094	.89
CD4017	.55	CD40103	2.49
CD4018	.59	CD40107	.69
CD4020	.59	CD40109	1.49
CD4024	.49	CD4510	.69
CD4027	.35	CD4511	.69
CD4030	.29	CD4520	.75
CD4040	.65	CD4522	.79
CD4049	.29	CD4538	.79
CD4050	.29	CD4541	.69
CD4051	.59	CD4543	.79
CD4052	.59	CD4553	4.95
CD4053	.59	CD4555	.79
CD4059	3.95	CD4566	2.49
CD4063	1.95	CD4572 (MC14572)	.39
CD4066	.29	CD4583	.89
CD4069	.25	CD4584	.39
CD4070	.25	CD4585	.89
CD4071	.25	MC14411P	8.95
CD4072	.25	MC14490P	4.49

COMMODORE CHIPS

Part No.	Price	Part No.	Price	Part No.	Price
WD1770 Disk Cont.	19.95	6551 ACIA	3.29	8701 Clock Chip	9.95
SI-3052P 5V Pos. Reg. 2A	5.95	6560 VIC-I	10.95	*8721 PLA	14.95
6504A CPU	1.95	6567 VIC-II	14.95	8722 MMU	9.95
6507 CPU	4.95	6569 VIC PAL	14.95	*251104-04 Kernal ROM	10.95
6510 CPU	9.95	6572 VIC PAL-N	14.95	*325572-01 Logic Array	24.95
6520 PIA	1.75	6581 SID	14.95	*82S100PLA (906114-01)**	13.95
6522 VIA	2.95	8360 Text Editing	10.95	901225-01 Char. ROM	11.95
6525 TPI	7.95	8501 MPU	10.95	901226-01 BASIC ROM	11.95
6526 CIA	14.95	8502 MPU	7.95	901227-03 Kernal ROM	11.95
6529 SPI	4.95	8563 CRT Contr.	15.95	901229-05 Upgrd. ROM	15.95
6532 128x8 RAM, I/O, Tim Ar	6.49	8564 VIC	15.95	*No spec. available	
6545-1 CRTC	2.49	8566 VIC PAL	39.95	**NOTE: 82S100PLA = U17 (C-64)	

NEC V20 & V30 CHIPS

Replace the 8086 or 8088 in Your IBM-PC and Increase Its Speed by up to 40%!

Part No.	Price
UPD70108-5 (5MHz) V20 Chip (Replaces the 8088)	$ 9.95
UPD70108-8 (8MHz) V20 Chip (Replaces the 8088-2)	$11.95
UPD70116-8 (8MHz) V30 Chip (Replaces the 8086 or 8086-2)	$14.95
UPD70116-10 (10MHz) V30 Chip (Replaces the 8086 or 8086-2)	$34.95

MICROPROCESSOR COMPONENTS

MISCELLANEOUS CHIPS Part No.	Price
D765AC	4.49
WD1770	19.95
2661-3	5.95
WD9216	9.95
Z80, Z80A, Z80B SERIES	
Z80	1.25
Z80-CTC	1.79
Z80-DART	4.95
Z80-PIO	1.79
Z80A	1.35
Z80A-CTC	1.49
Z80A-DART	4.95
Z80A-PIO	1.49
Z80A-SIO/0	4.95
Z80B	2.95
Z80B-CTC	3.49
Z80B-PIO	4.29
6500/6800/68000 SER.	
6502	2.25
65C02 (CMOS)	8.95
6520	1.75
6522	2.95
6532	6.49
6551	3.29
6800	1.75
6802	3.49
6810	1.25
6821	1.29

6500/6800/68000 Cont. Part No.	Price
6840	3.95
6843	2.95
6845	2.95
6850	1.49
6852	3.95
6875	8.95
MC68000L8	11.95
MC68000L10	19.95
8000 SERIES	
8031	2.95
80C31BH	14.95
8035	1.49
8073	29.95
8080A	2.49
8085A	2.29
8086	6.95
8086-2	8.95
8087 (5MHz)	125.00
8087-2 (8MHz)	159.95
8088	6.49
8088-2	8.95
8116	4.95
8155	1.95
8155-2	2.49
8156	2.49
8202	9.95
8203	14.95
8212	1.49
8224	2.25

8000 SERIES Cont. Part No.	Price
8228	2.49
8237-5	4.95
8243	2.25
8250A	5.49
8250B (For IBM)	6.95
8251A	1.75
8253-5	1.95
8254	2.95
8255A-5	1.69
8257-5	2.49
8259-5	1.95
8272	4.49
8279-5	2.95
8741	10.95
8748	7.95
8749	9.95
8751	39.95
8755	14.95
DATA ACQUISITION	
ADC0804LCN	3.19
ADC0808CCN	5.95
ADC0809CCN	3.95
ADC0816CCN	14.95
ADC0817CCN	8.95
DAC0808LCN	1.95
DAC1008LCN	6.49
AY-3-1015D	4.95
AY-5-1013A	3.95

DYNAMIC RAMS

Part No.	Function		Price
4116-15	16,384 x 1	(150ns)	.89
4128-20 (Piggyback)	131,072 x 1	(200ns)	4.49
4164-150	65,536 x 1	(150ns)	1.15
4164-200	65,536 x 1	(200ns)	.95
TMS4416-12	16,384 x 4	(120ns)	4.25
8118	16,384 x 1	(120ns)	.69
41256-150	262,144 x 1	(150ns)	2.75
50464-15	65,536 x 4	(150ns) (4464) (41464)	4.95
511000P-10	1,048,576 x 1	(100ns) 1 Meg	39.95
514256P-10	262,144 x 4	(100ns) 1 Meg	44.95

STATIC RAMS

2016-12	2048 x 8	(120ns)	1.69
2102-2L	1024 x 1	(250ns) Low Power (91L02)	1.95
2114N	1024 x 4	(450ns)	.99
2114N-2	1024 x 4	(200ns)	1.05
2114N-2L	1024 x 4	(200ns) Low Power	1.49
21C14	1024 x 4	(200ns) (CMOS)	.49
2149	1024 x 4	(45ns)	4.95
5101	256 x 4	(450ns) CMOS	1.95
6116LP-2	2048 x 8	(120ns) Low Power CMOS	2.95
6116P-3	2048 x 8	(150ns) CMOS	1.89
6116LP-3	2048 x 8	(150ns) Low Power	1.95
6264LP-12	8192 x 8	(120ns) Low Power CMOS	4.25
6264P-15	8192 x 8	(150ns) CMOS	3.59
6264LP-15	8192 x 8	(150ns) Low Power CMOS	3.75
6514	1024 x 4	(350ns) CMOS (UPD444C)	4.49
43256-15L	32,768 x 8	(150ns) Low Power	24.95

PROMS/EPROMS

1702A	256 x 8	(1 μs)	6.95
TMS2516	2048 x 8	(450ns) 25V	4.95
TMS2532	4096 x 8	(450ns) 25V	5.95
TMS2564	8192 x 8	(450ns) 25V	8.95
2708	1024 x 8	(450ns)	4.95
TMS2716	2048 x 8	(450ns) 3 voltage	9.95
2716	2048 x 8	(450ns)	3.75
2716-1	2048 x 8	(350ns) 25V	4.95
27C16	2048 x 8	(450ns) 25V (CMOS)	6.49
2732	4096 x 8	(450ns)	3.95
2732A-20	4096 x 8	(200ns) 21V	4.25
2732A-25	4096 x 8	(250ns) 21V	3.95
2732A-45	4096 x 8	(450ns) 21V	3.75
27C32	4096 x 8	(450ns) 25V (CMOS)	6.49
2764-20	8192 x 8	(200ns) 21V	4.25
2764-25	8192 x 8	(250ns) 21V	3.75
2764A-25	8192 x 8	(250ns) 12.5V	4.25
2764-45	8192 x 8	(450ns) 21V	3.49
27C64	8192 x 8	(450ns) 21V (CMOS)	5.49
27128-20	16,384 x 8	(200ns) 128K 21V	4.95
27128-25	16,384 x 8	(250ns) 128K 21V	4.25
27128A-25	16,384 x 8	(250ns) 12.5V	4.95
27C128-25	16,384 x 8	(250ns) 21V (CMOS)	5.95
27256-25	32,768 x 8	(250ns) 256K (12.5V)	5.95
27C256-25	32,768 x 8	(250ns) 256K (CMOS) (12.5V)	8.95
27512-25	65,536 x 8	(250ns) 512K (12.5V)	19.95
68764	8192 x 8	(450ns) 25V	15.95
68766	8192 x 8	(350ns) 25V	16.95
74S387	256 x 4	PROM O.C.	1.29
74S471	256 x 8	PROM T.S.	4.95
N82S123	32 x 8	PROM T.S.	2.49

SATELLITE TV DESCRAMBLER CHIP

The MM5321 is a TV camera sync generator designed to supply the basic sync functions for either color or monochrome 525 line/60Hz interfaced and camera video recorder applications. **COLOR BURST GATE & SYNC ALLOW STABLE COLOR OPERATION**

MM5321N. $11.95

INTERSIL Also Available!

74HC HI-SPEED CMOS

Part No.	Price	Part No.	Price
74HC00	.25	74HC175	.69
74HC02	.25	74HC221	.99
74HC04	.29	74HC240	.79
74HC08	.29	74HC244	.79
74HC10	.29	74HC245	.89
74HC14	.49	74HC253	.59
74HC30	.29	74HC259	.65
74HC32	.29	74HC273	.79
74HC74	.39	74HC373	.79
74HC75	.39	74HC374	.79
74HC76	.45	74HC393	.75
74HC85	.79	74HC595	1.19
74HC86	.39	74HC688	.79
74HC123	.89	74HC4040	.89
74HC125	.49	74HC4049	.59
74HC132	.49	74HC4050	.59
74HC138	.49	74HC4060	1.09
74HC139	.49	74HC4511	1.29
74HC154	1.19	74HC4514	1.19
74HC163	.65	74HC4538	.89
74HC174	.69	74HC4543	1.19

74HCT — CMOS TTL

74HCT00	.29	74HCT139	.59
74HCT02	.29	74HCT157	.69
74HCT04	.29	74HCT174	.69
74HCT08	.29	74HCT175	.69
74HCT10	.29	74HCT240	.99
74HCT32	.29	74HCT244	.99
74HCT74	.49	74HCT245	1.19
74HCT86	.49	74HCT373	1.19
74HCT138	.59	74HCT374	1.19

74C—CMOS

74C00	.29	74C174	.79
74C02	.29	74C175	.79
74C04	.29	74C221	1.49
74C08	.35	74C240	1.29
74C10	.35	74C244	1.29
74C14	.49	74C373	1.49
74C32	.35	74C374	1.49
74C74	.59	74C912	7.95
74C85	1.39	74C915	1.39
74C86	.35	74C920	9.95
74C89	5.19	74C921	9.95
74C90	.99	74C922	3.95
74C154	2.95	74C923	3.95
74C173	1.05	74C925	5.95

LINEAR

DS0026CN	1.95	LM1458N	.39
TL074CN	.89	LM1488N	.49
TL084CN	.99	DS14C88N (CMOS)	1.19
AF100-ICN	8.95	LM1489N	.49
LM307N	.45	DS14C89N (CMOS)	1.19
LM309K	1.25	LM1496N	.85
LM311N	.45	MC1648P	4.95
LM317T	.79	LM1871N	2.95
LM318N	.99	LM1872N	2.95
LM319N	.99	LM1896N-1	1.59
LM323K	3.95	ULN2003A	.99
LM324N	.39	XR2206	3.95
LM338K	4.95	XR2211	2.95
LM339N	.39	XR2243	1.95
LF347N	1.79	DS26LS29CN	4.49
LM348N	.69	DS26LS31CN	1.19
LM350T	2.95	DS26LS32CN	1.19
LF351N	.39	DS26LS33CN	1.95
LF353N	.49	LM2901N	.49
LF355N	.79	LM2907N	2.49
LF356N	.79	LM2917N (8 pin)	1.55
LF357N	1.09	MC3419CL	9.95
LM358N	.49	MC3446N	2.95
LM360N	2.19	MC3450P	2.95
LM361N	1.79	MC3470P	1.95
LM380N-8	.99	MC3471P	4.95
LM386N-3	.99	MC3479P	4.79
LM387N	.99	MC3486P	1.69
LM393N	.39	MC3487P	1.69
LM399H	2.95	LM3900N	.49
LF411CN	.79	LM3905N	1.19
TL497ACN	2.69	LM3909N	.99
NE540H (C540H)	2.95	LM3914N	1.95
NE555V	.29	LM3916N	1.95
XR-L555	.75	NE5532	.89
LM556N	.49	NE5534	.69
NE558N	.89	7805K (LM340K-5)	1.29
LM565N	.99	7812K (LM340K-12)	1.29
LM567V	.69	7815K (LM340K-15)	1.29
NE592N	.89	7805T (LM340T-5)	.49
LM741CN	.29	7812T (LM340T-12)	.49
LM747CN	.59	7815T (LM340T-15)	.49
MC1350	1.49	7905K (LM320K-5)	1.35
MC1372P	2.49	7905T (LM320T-5)	.59
MC1377P	3.19	75472	.99
MC1398P	8.95	75477	1.29
LM1414N	1.29	76477	5.95
		MC145406P	2.95

IC SOCKETS

Low Profile		Wire Wrap (Gold) Level #3	
8 pin LP	.11	8 pin WW	.59
14 pin LP	.12	14 pin WW	.65
16 pin LP	.13	16 pin WW	.69
24 pin LP	.25	24 pin WW	1.19
28 pin LP	.27	28 pin WW	1.39
40 pin LP	.29	40 pin WW	1.89

Soldertail Standard (Gold & Tin) & Header Plug Sockets Also Available

PARTIAL LISTING • OVER 4000 COMPONENTS AND ACCESSORIES IN STOCK! • CALL FOR QUANTITY DISCOUNTS

Inquiry 150

Worldwide • Since 1974
• QUALITY COMPONENTS • COMPETITIVE PRICING • PROMPT DELIVERY

Mail Order Electronics · Worldwide
Jameco ELECTRONICS

COMMODORE® COMPATIBLE ACCESSORIES



HESWARE 300 Baud Modem
For VIC-20 and C-64

• Connects directly to User Port • Manual Answer/Dial • Function keys defined for convenience • Includes Midwest Micro Associates communication software.

CM-1 (For VIC-20 and C-64) ~~$34.95~~ **$24.95**

Four-Slot Cartridge Expander
Singly or in any combination!

Aprospand-64 (For C-64 & C-128) **$29.95**

External Power Supply
CPS-10 (For C-64) **$39.95**

Parallel Printer Interface
2K Buffer, Expandable to 10K!

MW-350 (For VIC-20, C-64 & C-128) **$54.95**

Input/Output Card
16-Channel Analog Multiplexer

MW-611 (For C-64 and C-128) **$199.95**

TRS-80/TANDY® COMPATIBLE ACCESSORIES

E-X-P-A-N-D TRS-80 MEMORY
All kits come complete with documentation

TRS-80 MODEL 4, 4P, & 4D 64K/128K EXPANSION

TRS-64K-2 . . . . . **$7.95**
Expands Model 4 from 16K-64K or Model 4 (Gate Array Version), 4P and 4D from 64K-128K

TRS-64K-2PAL **$14.95**
Expands Model 4 (Non-Gate Array Version) from 64K to 128K

TRS-80 MODEL 100 8K EXPANSION

M1008K . . . . . **$19.95 ea. or 3 for $54.95**

ZUCKERBOARD

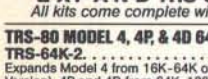


TANDY 1000 Expansion Memory Half Card

Expand the memory of your Tandy 1000 (128K Version) to as much as 640K. Also includes DMA controller chip.

TAN-EM256K Includes 256K RAM. . . . . **$ 99.95**
TAN-EM512K Includes 512K RAM. **$119.95**

Options for TAN-EM256K/512K
TAN-C Plug-in Clock option chip (only). **$39.95**
TAN-D RAM Disk Printer Spooler Software (only) **$39.95**



TANDY 1000 Multifunction Board with Clock Calendar

Expand the memory on your Tandy 1000 (128K Version) to as much as 640K. Complete with an RS232 port, clock/calendar, RAM Disk Printer Spooler and on-board DMA controller chip.

MTAN-256K Includes 256K RAM. **$179.95**
MTAN-512K Includes 512K RAM. **$199.95**

UV-EPROM ERASER



Erases all EPROMs. Erases up to 8 chips within 21 minutes (1 chip in 15 minutes). Maintains constant exposure distance of 1". Special conductive foam liner eliminates static build-up. Built-in safety lock to prevent UV exposure. Compact - 9.00"L x 3.70"W x 2.60"H. Complete with holding tray for 8 chips.

DE-4 UV-EPROM Eraser. . . . **$69.95**
UVS-11EL Replacement Bulb. . . . **$19.95**
NCF-2 Cond. Foam 12x24x¼ Hard Blk. **$ 8.95**

NOW YOU CAN BUILD AN IBM PC/XT COMPATIBLE!



IBM Compatible Kit

IBM-64K(2)	64K RAM Chips (18)	$ 19.90
KB83	83-Key Keyboard	$ 29.95
IBM-FCC	Floppy Controller Card	$ 34.95
IBM-Case	Case	$ 39.95
IBM-MCC	Monochrome Card	$ 59.95
IBM-PS	Power Supply	$ 69.95
FD55B	Disk Drive	$109.95
IBM-MON	Monochrome Monitor	$ 99.95
IBM-MB	Motherboard	$109.95

FREE! QUICKSOFT PC WRITE WORD PROCESSING SOFTWARE INCLUDED!

Regular List $574.50

IBM-Special (Includes 9 items above) **$499.95**

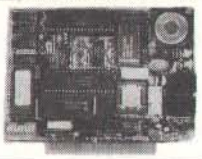
ADDITIONAL ADD-ONS AVAILABLE!

IBM-KB	83-Key Keyboard	$ 59.95
IBM-ENH	Enhanced Keyboard	$ 79.95
IBM-ICB	Integrated Color Board w/Printer Port	$ 99.95
IBM-EGA	Enhanced Graphics 256K RAM	$249.95
IBM-MGA	Monochrome Graphics Adapter	$149.95
IBM-MULTI	Multifunction 0-384K RAM (without RAM)	$149.95
IBM-20MBK	20MB Hard Disk Drive, Controller & Cable	$429.95
EM-100	Expansion Memory Half Card (without RAM)	$ 59.95
TTX-1410	14" RGB Color Monitor	$299.95

IBM is a registered trademark of IBM Computers

NEW PRODUCTS!

PROMETHEUS PRODUCTS, INC.



ProModem 1200/300 Baud Half-Card Modems
For IBM PC, XT, AT & Compatibles

• Auto-answer/Auto-dial • Extensive diagnostics • Built-in speaker/vol. control • Auto redial on busy • Ability to access Com-port 3 • Hayes compatible • 2 yr. warranty

PM1200B-2 without software **$129.95**
PM1200B-2S w/Mirror™ Software . . . **$159.95**

2 yr. warranty! **ZOOM 300 Baud Modem for Apple II, II+ and *IIe***



• Auto-dial/Auto-answer • Hayes compatible • Includes call progress monitor, speaker, Zoom Communications software and manual • Made in U.S.A.

ZM300 . . . . . **$79.95**

PROMETHEUS PRODUCTS, INC.

ProModem 1200/300 for Apple II, II+, *IIe* and II GS
Fully Compatible with the NEW APPLE II GS!



• **NEW, single card version** • Built-in software in ROM • Comes with ProCom-A disk-based communications software • Hayes compatible • Compatible with ProDOS • Auto-dial/Auto-answer • Auto redial on busy • Built-in speaker and volume control • 2 phase jacks with exclusion switching • 2-year warranty

PM1200A-2 . . . . **$199.95**

ProModem 2400/1200/300 Baud Modems
For Any Computer w/RS232 Serial Port

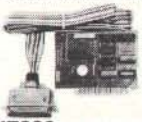


• Hayes command compatible • Call progress tone detection • Auto redial on busy • Internal power supply • Voice/data switching • Second phone jack for voice handset • Auto-answer/Auto-dial • Touch tone and pulse dialing • Speaker with volume control • 8 LED status lights • 1-year warranty

PM1200G (1200/300 baud) **$199.95**
PM2400G (2400/1200/300 baud) . . . **$379.95**
ProCom-B (Communication Software . . . For IBM PC and Compatibles) **$34.95**

APPLE COMPATIBLE ACCESSORIES

Jameco ELECTRONICS Parallel Printer Card for Apple II, II+ and *IIe*



• Intelligent interface to most dot matrix graphics printers
• Centronics standard
• Advanced text printing

JE880 Parallel Printer Card. **$49.95**
JE883 64K Buffer for JE880 ~~$69.95~~ **$59.95**

Jameco ELECTRONICS Extended 80-Column Card for Apple *IIe*



• 80 Col./64K RAM • Doubles amount of data your Apple *IIe* can display as well as its memory capacity • Ideal for word processing • Complete with instructions

JE864 $59.95

Apple II, II+ and *IIe* Compatible Products

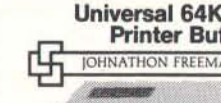
APF-1	Cooling Fan	$ 29.95
KHP4007	Switching Power Supply	$ 34.95
JE860	16K RAM Card (II & II+ only)	$ 39.95
JE875	Disk Controller Card	$ 49.95
JE877	Diagnostic Disk Controller Card ~~$59.95~~	$ 49.95
AMON	Monochrome Monitor	$ 99.95
SMARTERM II	80-Col. Card	$139.95
Big Board-256K	256K RAM Card	$189.95
Big Board-512K	512K RAM Card	$219.95
Big Board-1M	1 Meg RAM Card	$289.95

Universal 64K/256K Printer Buffer
JOHNATHON FREEMAN DESIGNS



• Four possible combinations: 1) Serial to Serial, 2) Serial to Parallel, 3) Parallel to Parallel, 4) Parallel to Serial • Cut sheet feeding • Software selectable output • Modem support • Selectable baud rates • Manual included

UB64K **$199.95**
UB256K **$239.95**



***IBM Compatible!* DISK DRIVES**
Documentation Included

FD55B Teac 5¼" DS ½-Height **$109.95**
JU-455 Panasonic 5¼" DS ½-Height . . . **$109.95**
TM100-2 Tandon 5¼" DS Full-Height . . . **$119.95**

DATA BOOKS

30003	National Linear Data Book (82)	$14.95
30009	Intersil Data Book (86)	$ 9.95
30013	Zilog Data Book (85)	$14.95
30032	National Linear Supplement (84)	$ 6.95
210830	Intel Memory Handbook (86)	$17.95
230843	Intel Microsystem Hndbk. Set (86)	$24.95

MUFFIN/SPRITE-STYLE FANS



MUF60 . . . . . **$9.95**
Torin Industries (4.68" sq., 60 cfm)

SU2A1 . . . . . **$8.95**
EG&G Rotron (3.125" square, 20 cfm)

$20 Minimum Order — U.S. Funds Only
Shipping: Add 5% plus $1.50 Insurance

California Residents: Add 6%, 6½% or 7% Sales Tax

Spec. Sheets — 50¢ each
Prices Subject to Change

Send stamped, self-addressed envelope to receive a Sales Flyer — FREE!
3/87

MasterCard

Mail Order Electronics · Worldwide
Jameco ELECTRONICS®

VISA®

Send $1.00 Postage for a FREE 1987 JAMECO CATALOG

©1987 Jameco Electronics

1355 SHOREWAY ROAD, BELMONT, CA 94002 • *PHONE ORDERS WELCOME 415-592-8097 Telex: 176043*

JADE TURBO or 286



- 640K of RAM
- 7 MHz turbo mode
- 360K disk drive
- 5151 or AT style
- 8 expansion slots

$568

- 640K of RAM
- 8 MHz 80286
- 1.2 MB disk drive
- AT-style keyboard/case
- 8 expansion slots

$1198

OPTION #1
Mono graphics card
Parallel printer port
Monochrome monitor

TURBO $698 286 $1398

OPTION #2
20 MB hard disk
Parallel printer port
Monochrome monitor

TURBO $1098 286 $1698

OPTION #3
20 MB hard disk
Color graphics card
Parallel printer port
Hitachi hi-res color monitor

TURBO $1269 286 $1898

360K DISK DRIVE

Built by Alpine Electronics to IBM specifications, same as Qume 142



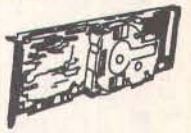
- 360K
- 48 TPI
- Double-sided
- Double density
- Half height

10-99 **$69.95** 100+
$65.95 LIST PRICE $199 $61.50

Dual drive mounting kit ____ $9.95

21 Megabyte Hard DISK ON A Card

$399



- 21.3 MB Formatted
- Lowpower.
- Head Park Zone
- Plated Media
- Light 2.4 lbs.

HARD DISK DRIVE



$299

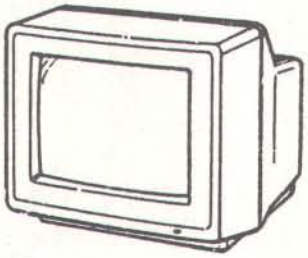
HARD DISK, CONTROLLER AND CABLES

10 MB Internal Kit ____ $299
20 MB Internal Kit ____ $369
30 MB Internal Kit ____ $499

HIGH RESOLUTION COLOR MONITOR

$269

List Price $699



- High resolution 640 x 240
- Excellent dot pitch .38 mm
- 16 true colors, 2000 characters
- Accepts standard RGB input signals
- Non-glare picture tube
- Free PC RGB cable included
- Per tilt & swivel add $5.00

Manufactured by Hitachi

HITACHI

EGA PACKAGE

$629

List Price $998

EGA Monitor Plus EGA Video Card

Hi-res EGA video card ____ $239
Hi-res EGA monitor ____ $399

- Dual Mode Monitor
- Non Glare, .31 Dot Pitch
- 640 x 350, 640 x 200
- EGA, CGA, MDA
- 100% IBM Compatible
- 256K of Video RAM

HIGH PERFORMANCE

20 MB HARD DISK FOR YOUR AT

$299

Includes drive, mounting rails and cable

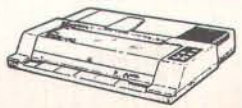
30 Megabyte AT Kit ____ $499
40 Megabyte AT Kit ____ $699

EPSON PLOTTER

$198

List Price $599

HI-80 FOUR PEN PLOTTER



- 9 inch/SEC
- Min. step .1 mm
- Repetition .3 mm
- One year Epson warranty
- Centronics Parallel
- Parallel IBM Software

2 pen serial HP-GL conversion (HP 7470) ____ $39

MICROSPEED FAST 88

7 MHz TURBO CARD FOR YOUR PC

$99

- Top rated
- Uses no slots
- 6.14, 6.67 and 7.37 MHz
- No wait states
- External switch
- Reset switch

3½" DISK DRIVE FOR YOUR PC/XT/AT

720K Disk Drive for Mass Storage or for Down Loading to your Lap-Top Computer
Requires DOS 3.20

$149

RGB Color Monitors

Hitachi 640 x 240	$269
Magnavox 640 x 240	$319
Magnavox EGA 640 x 350	$489
Jade EGA 640 x 350	$399
Thompson Ultra Scan 800x 560	$579
Quimax EGA 640 x 350	$489
NEC Multisync 800 x 560	$599
PGS HX-12 640 x 240	$439
PGS HX-12E 640 x 350	$529

PC Mouse

PC Mouse w/Dr. Halo II	$119
Microsoft Mouse with software	$129

PC Power Supply

135 watt power supply	$69
150 watt power supply	$79
200 watt power supply	$99

PC or AT Video Boards

Hercules Color Graphics	$159
Jade Color Graphics	$89
Hercules Mono Graphics Plus	$199
JADE Monochrome Graphics	$99
Quad EGA+	$359
Video 7 Vega EGA	$339
JADE EGA+ EGA, CGA, MDA	$239
JADE EGA+ Above Plus HGA	$289

High Speed APU Chips

8087-3 5 MHz	$119
8087-2 8 MHz	$159
80287-3 5 MHz	$179
80287-8 8 MHz	$269
NEC V-20 8 MHz	$14
NEC V-30 8 MHz	$16

MICROSOFT MS-DOS 3.20

Including GW-BASIC
Supports 3½" Drive

$88

Monochrome Monitors

Jade green TTL	$99
Jade amber TTL	$99
Amdek 310A amber	$149
Magnavox green Hi-res TTL	$119
Magnavox amber Hi-res TTL	119
PGS MAX 12E amber	$159

22 CPS DAISYWHEEL PRINTER

$199

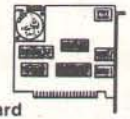
- Diablo 630 Compatible
- Proportional spacing
- 2K Buffer
- Parallel and serial

Adjustable Tractor	$69
Auto sheet feeder	$159
Extra ribbon	$5

Modems

1200 BAUD MODEM

$129



Internal 1200 baud card with software	$129
External 1200 baud	$139
Internal 2400 baud card with software	$299
Hayes 1200B internal card w/o software	$329
Hayes 1200B internal card w/Smartcom II	$359
Hayes Smartmodem 1200	$389
Hayes 2400B internal card w/Smartcom II	$549
Hayes Smartmodem 2400	$589

NO-SLOT CLOCK

For Your Apple, PC-XT or Clone



$49

- Uses No Slot
- 20 Year Battery
- Includes Software

Real time clock/calendar for your IBM PC-XT, Clone Apple II+, IIe or IIc (Please Specify)

Plug -in Cable Board for PC $49

Iso-Bar

These industrial quality ISO-BAR's contain surge suppression circuitry & built-in noise filters plus a 15 amp circuit breaker.

6 socket, 1 filter ISO-BAR	$44
4 socket, 2 filter ISO-BAR	$59
8 socket, 4 filter ISO-BAR	$69
200W standby power supply	$269
450W standby power supply	$399
675W standby power supply	$599
1000W standby power supply	$899

Plotters

ROLAND DXY-800 8 COLOR

8 PEN PLOTTER

$399

List Price $899

- Serial and Parallel
- A and B size Plots up to 17"x11"
- AUTOCAD compatibility
- 1% accuracy, .1mm step & .3mm repete

PC Multifunction Cards

384K Jade Seven Pak w/0K, p, s, c, c, g, software	$89
384K Jade Seven Pak with 384K installed	$139
AST Six Pak Plus 64K	$159
AST Six Pak Plus 384K	$229
AST Six Pak Premium 512K	$389

LASER PRINTERS

6 PAGE Per Minute **$1750**

10 PAGE Per Minute **$1950**

CALL FOR DETAILS!

Disk Drive For Your APPLE

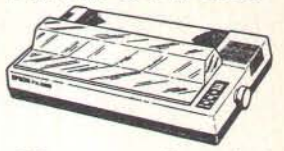


as low as **$99**

20 MB hard disk	$799
IIc ½ high disk drive	$119
IIe ½ high disk drive	$99
IIe, II+ disk drive	$129
IIe 64K, 80 column card	$49
II+ 80 column card	$119
Grappler printer card	$89
II+ 16K RAM card	$39
1MB RAM card w/0 k	$129
II+, IIe printer card & cable	$49
II+, IIe cooling fan	$59

Epson Printers In Stock

NEW EPSON FX-86e & FX-286e



- 240 cps
- Graphics
- Tractor feed
- Friction feed

CALL FOR OUR BEST PRICE!

Citizen 120D 120 cps	$198
Okidata 192 160 cps	$339
Epson LX-86 120 cps	IN STOCK
Epson LQ-800 24 pin	IN STOCK
Epson LQ-1000 24 pin	IN STOCK
Epson EX-800 300 cps	IN STOCK
Epson EX-1000 300 cps	IN STOCK
Epson LQ-2500 324 cps	IN STOCK

Microfazer Buffers

Expands to 64K (Parallel to 512K)

8K	Parallel in/parallel out $139
64K	Parallel in/parallel out $164
128K	Parallel in/parallel out $269
512K	Parallel in/parallel out $499

Your choice: serial in/serial out; parallel in/serial out; serial in/parallel out.

8K $169 **64K** $199

64K BUFFER FOR YOUR EPSON

Serial or parallel input. Fits MX, RX, FX printers

Limited Quantity **$99**

JADE COMPUTER

4901 W. Rosecrans Ave. Box 5046 Hawthorne, CA 90251-5046

VISA MasterCard AMERICAN EXPRESS

Prices at our six store locations will be higher.
We accept cash, checks, credit cards or purchase orders from qualified firms and institutions. **Minimum prepaid order $15.00.** Ca. & Tx. residents add sales tax. **Prices and availability subject to change without notice.** Shipping & handling charges via UPS Ground 50¢/lb. UPS Air $1.00/lb. **Minimum charge $3.00.**

PLACE ORDERS TOLL FREE!
Continental U.S.A.
(800)421-5500
Inside California
(800)262-1710

1200 BAUD MODEM FOR IBM WITH PC TALK III SOFTWARE $109.95

STATIC RAMS

2101	256x4	(450ns)	1.95
5101	256x4	(450ns)(CMOS)	3.95
2102L-4	1024x1	(450ns)(LP)	.99
2112	256x4	(450ns)	2.99
2114	1024x4	(450ns)	.99
2114L-4	1024x4	(450ns)(LP)	1.09
2114L-2	1024x4	(200ns)(LP)	1.49
2114L-15	1024x4	(150ns)(LP)	1.95
TMS4044-4	4096x1	(450ns)	1.95
TMM2016-150	2048x8	(150ns)	1.49
TMM2016-100	2048x8	(100ns)	1.95
HM6116-4	2048x8	(200ns)(CMOS)	1.89
HM6116-3	2048x8	(150ns)(CMOS)	1.95
HM6116LP-4	2048x8	(200ns)(CMOS)(LP)	1.95
HM6116LP-3	2048x8	(150ns)(CMOS)(LP)	2.05
HM6116LP-2	2048x8	(120ns)(CMOS)(LP)	2.95
HM6264P-15	8192x8	(150ns)(CMOS)	3.89
HM6264LP-15	8192x8	(150ns)(CMOS)(LP)	3.95
HM6264LP-12	8192x8	(120ns)(CMOS)(LP)	4.49

LP=Low power

DYNAMIC RAMS

4116-250	16384x1	(250ns)	.49
4116-200	16384x1	(200ns)	.89
4116-150	16384x1	(150ns)	.99
4116-120	16384x1	(120ns)	1.49
MK4332	32768x1	(200ns)	6.95
4164-200	65536x1	(200ns)(5v)	1.19
4164-150	65536x1	(150ns)(5v)	1.29
4164-120	65536x1	(120ns)(5v)	1.95
MCM6665	65536x1	(200ns)(5v)	1.95
TMS4164	65536x1	(150ns)(5v)	1.95
4164-REFRESH	65536x1	(150ns)(5V)(REFRESH)	2.95
TMS4416	16384x4	(150ns)(5v)	4.95
41128-150	131072x1	(150ns)(5v)	5.95
TMS4464-15	65536x4	(150ns)(5v)	6.95
41256-200	262144x1	(200ns)(5v)	2.95
41256-150	262144x1	(150ns)(5v)	2.95

5v=Single 5 Volt Supply REFRESH=Pin 1 Refresh

★★★★HIGH-TECH★★★★

NEC V20 UPD70108 $11.95

REPLACES 8088 TO SPEED UP IBM PC 10-40%

- HIGH-SPEED ADDRESS CALCULATION IN HARDWARE
- PIN COMPATIBLE WITH 8088
- SUPERSET OF 8088 INSTRUCTION SET
- LOW POWER CMOS

8MHz	V20	UPD70108-8	$13.95
8MHz	V30	UPD70116-8	$19.95

★★★★SPOTLIGHT★★★★

ORDER TOLL FREE 800-538-5000

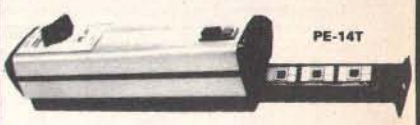
VISA MasterCard

EPROMS

2708	1024x8	(450ns)	4.95
2716	2048x8	(450ns)(5V)	3.49
2716-1	2048x8	(350ns)(5V)	3.95
TMS2532	4096x8	(450ns)(5V)	5.95
2732	4096x8	(450ns)(5V)	3.95
2732A	4096x8	(250ns)(5V)(21V PGM)	3.95
2732A-2	4096x8	(200ns)(5V)(21V PGM)	4.25
27C64	8192x8	(250ns)(5V)(CMOS)	5.95
2764	8192x8	(450ns)(5V)	3.49
2764-250	8192x8	(250ns)(5V)	3.95
2764-200	8192x8	(200ns)(5V)	4.25
MCM68766	8192x8	(350ns)(5V)(24 PIN)	17.95
27128	16384x8	(250ns)(5V)	4.25
27C256	32768x8	(250ns)(5V)(CMOS)	10.95
27256	32768x8	(250ns)(5V)	7.49

5V=Single 5 Volt Supply 21V PGM=Program at 21 Volts

SPECTRONICS CORPORATION EPROM ERASERS



Model	Timer	Capacity Chip	Intensity (uW/Cm²)	Unit Price
PE-14	NO	9	8,000	$83.00
PE-14T	YES	9	8,000	$119.00
PE-24T	YES	12	9,600	$175.00

8000

8035	1.49
8039	1.95
8080	2.95
8085	2.49
8087-2	169.95
8087	129.00
8088	6.95
8088-2	9.95
8155	2.49
8155-2	3.95
8748	7.95
8755	14.95
80286	129.95
80287	199.95

8200

8203	24.95
8205	3.29
8212	1.49
8216	1.49
8224	2.25
8237	4.95
8237-5	5.49
8250	6.95
8251	1.69
8251A	1.89
8253	1.89
8253-5	1.95
8255	1.69
8255-5	1.89
8259	1.95
8259-5	2.29
8272	4.95
8279	2.49
8279-5	2.95
8282	3.95
8284	2.95
8286	3.95
8288	4.95

Z-80

Z80-CPU 2.5 MHz 1.69

4.0 MHz

Z80A-CPU	1.79
Z80A-CTC	1.89
Z80A-DART	5.95
Z80A-DMA	5.95
Z80A-PIO	1.89
Z80A-SIO/0	5.95
Z80A-SIO/1	5.95
Z80A-SIO/2	5.95

6.0 MHz

Z80B-CPU	3.75
Z80B-CTC	4.25
Z80B-PIO	4.25
Z80B-DART	14.95
Z80B-SIO/0	12.95
Z80B-SIO/2	12.95
Z8671 ZILOG	19.95

6500

1.0 MHz

6502	2.69
65C02 (CMOS)	12.95
6507	9.95
6520	1.95
6522	4.95
6526	26.95
6532	6.95
6545	6.95
6551	5.95
6561	19.95
6581	34.95

2.0 MHz

6502A	2.95
6520A	2.95
6522A	5.95
6532A	11.95
6545A	7.95
6551A	6.95

3.0 MHz

6502B	6.95

6800

1.0 MHz

6800	1.95
6802	4.95
6803	9.95
6809	5.95
6809E	5.95
6810	1.95
6820	2.95
6821	1.95
6840	6.95
6843	19.95
6844	12.95
6845	4.95
6847	11.95
6850	1.95
6883	22.95

2.0 MHz

68B00	4.95
68B02	5.95
68B09E	6.95
68B09	6.95
68B21	3.95
68B45	6.95
68B50	2.95
68B54	7.95

CLOCK CIRCUITS

MM5369	1.95
MM5369-EST	1.95
MM58167	12.95
MM58174	11.95
MSM5832	2.95

CRT CONTROLLERS

6845	4.95
68B45	8.95
6847	11.95
HD46505SP	6.95
MC1372	2.95
8275	26.95
7220	19.95
CRT5027	12.95
CRT5037	9.95
TMS9918A	19.95

DISK CONTROLLERS

1771	4.95
1791	9.95
1793	9.95
1795	12.95
1797	12.95
2791	19.95
2793	19.95
2797	29.95
6843	19.95
8272	4.95
UPD765	4.95
MB8876	12.95
MB8877	12.95
1691	6.95
2143	6.95

BIT RATE GENERATORS

MC14411	9.95
BR1941	4.95
4702	9.95
COM8116	8.95
MM5307	4.95

UARTS

AY5-1013	3.95
AY3-1015	4.95
TR1602	3.95
2651	4.95
IM6402	6.95
IM6403	9.95
INS8250	6.95

SOUND CHIPS

76477	5.95
76489	8.95
SSI-263	39.95
AY3-8910	12.95
AY3-8912	12.95
SP1000	39.00

CRYSTALS

32.768 KHz	.95
1.0 MHz	2.95
1.8432	2.95
2.0	1.95
2.097152	1.95
2.4576	1.95
3.2768	1.95
3.579545	1.95
4.0	1.95
4.032	1.95
5.0	1.95
5.0688	1.95
6.0	1.95
6.144	1.95
6.5536	1.95
8.0	1.95
10.0	1.95
10.738635	1.95
12.0	1.95
14.31818	1.95
15.0	1.95
16.0	1.95
17.430	1.95
18.0	1.95
18.432	1.95
20.0	1.95
22.1184	1.95
24.0	1.95
32.0	1.95

CRYSTAL OSCILLATORS

1.0MHz	5.95
1.8432	5.95
2.0	5.95
2.4576	5.95
2.5	4.95
4.0	4.95
5.0688	4.95
6.0	4.95
6.144	4.95
8.0	4.95
10.0	4.95
12.0	4.95
12.480	4.95
15.0	4.95
16.0	4.95
18.432	4.95
20.0	4.95
24.0	4.95

MISC.

TMS99531	9.95
TMS99532	19.95
ULN2003	.79
3242	7.95
3341	4.95
MC3470	1.95
MC3480	8.95
MC3487	2.95
11C90	19.95
2513-001 UP	6.95
AY5-2376	11.95
AY5-3600 PRO	11.95

74LS00

74LS00	.16	74LS165	.65
74LS01	.18	74LS166	.95
74LS02	.17	74LS169	.95
74LS03	.18	74LS173	.49
74LS04	.16	74LS174	.39
74LS05	.18	74LS175	.39
74LS08	.18	74LS191	.49
74LS09	.18	74LS192	.69
74LS10	.16	74LS193	.69
74LS11	.22	74LS194	.69
74LS12	.22	74LS195	.69
74LS13	.26	74LS196	.59
74LS14	.39	74LS197	.59
74LS15	.26	74LS221	.59
74LS20	.17	74LS240	.69
74LS21	.22	74LS241	.69
74LS22	.22	74LS242	.69
74LS27	.23	74LS243	.69
74LS28	.26	74LS244	.69
74LS30	.17	74LS245	.79
74LS32	.18	74LS251	.49
74LS33	.28	74LS253	.49
74LS37	.26	74LS256	1.79
74LS38	.26	74LS257	.39
74LS42	.39	74LS258	.49
74LS47	.75	74LS259	1.29
74LS48	.85	74LS260	.49
74LS51	.17	74LS266	.39
74LS73	.29	74LS273	.79
74LS74	.24	74LS279	.39
74LS75	.29	74LS280	1.98
74LS76	.29	74LS283	.59
74LS83	.49	74LS290	.89
74LS85	.49	74LS293	.89
74LS86	.22	74LS299	1.49
74LS90	.39	74LS322	3.95
74LS92	.49	74LS323	2.49
74LS93	.39	74LS364	1.95
74LS95	.49	74LS365	.39
74LS107	.34	74LS367	.39
74LS109	.36	74LS368	.39
74LS112	.29	74LS373	.79
74LS122	.45	74LS374	.79
74LS123	.49	74LS375	.95
74LS124	2.75	74LS377	.79
74LS125	.39	74LS378	1.18
74LS126	.39	74LS390	1.19
74LS132	.39	74LS393	.79
74LS133	.49	74LS541	1.49
74LS136	.39	74LS624	1.95
74LS138	.39	74LS640	.99
74LS139	.39	74LS645	.99
74LS145	.99	74LS669	1.29
74LS147	.99	74LS670	.89
74LS148	.99	74LS682	3.20
74LS151	.39	74LS683	3.20
74LS153	.39	74LS684	3.20
74LS154	1.49	74LS688	2.40
74LS155	.59	74LS783	22.95
74LS156	.49	81LS95	1.49
74LS157	.35	81LS96	1.49
74LS158	.29	81LS97	1.49
74LS160	.29	81LS98	1.49
74LS161	.39	25LS2521	2.80
74LS162	.49	25LS2569	2.80
74LS163	.39	26LS31	1.95
74LS164	.49	26LS32	1.95

HIGH SPEED CMOS

A new family of high speed CMOS logic featuring the speed of low power Schottky (8ns typical gate propagation delay), combined with the advantages of CMOS: very low power consumption, superior noise immunity, and improved output drive.

74HC00

74HC: Operate at CMOS logic levels and are ideal for new, all-CMOS designs.

74HC00	.59	74HC148	1.19
74HC02	.59	74HC151	.89
74HC04	.59	74HC154	2.49
74HC08	.59	74HC157	.89
74HC10	.59	74HC158	.95
74HC14	.79	74HC163	1.15
74HC20	.59	74HC175	.99
74HC27	.59	74HC240	1.89
74HC30	.59	74HC244	1.89
74HC32	.69	74HC245	1.89
74HC51	.59	74HC257	.85
74HC74	.75	74HC259	1.39
74HC85	1.35	74HC273	1.89
74HC86	.69	74HC299	4.99
74HC93	1.19	74HC368	.99
74HC107	.79	74HC373	2.29
74HC109	.79	74HC374	2.29
74HC112	.79	74HC390	1.39
74HC125	1.19	74HC393	1.39
74HC132	1.19	74HC4017	1.99
74HC133	.69	74HC4020	1.39
74HC138	.99	74HC4049	.89
74HC139	.99	74HC4050	.89

74HCT00

74HCT: Direct, drop-in replacements for LS TTL and can be intermixed with 74LS in the same circuit.

74HCT00	.69	74HCT166	3.05
74HCT02	.69	74HCT174	1.09
74HCT04	.69	74HCT193	1.39
74HCT08	.69	74HCT194	1.19
74HCT10	.69	74HCT240	2.19
74HCT11	.69	74HCT241	2.19
74HCT27	.69	74HCT244	2.19
74HCT30	.69	74HCT245	2.19
74HCT32	.79	74HCT257	.99
74HCT74	.85	74HCT259	1.59
74HCT75	.95	74HCT273	2.09
74HCT138	1.15	74HCT367	1.09
74HCT139	1.15	74HCT373	2.49
74HCT154	2.99	74HCT374	2.49
74HCT157	.99	74HCT393	1.59
74HCT158	.99	74HCT4017	2.19
74HCT161	1.29	74HCT4040	1.59
74HCT164	1.39	74HCT4060	1.49

74F00

74F00	.69	74F74	.79	74F251	1.69
74F02	.69	74F86	.99	74F253	1.69
74F04	.79	74F138	1.69	74F257	1.69
74F08	.69	74F139	1.69	74F280	1.79
74F10	.69	74F157	1.69	74F283	3.95
74F32	.69	74F240	3.29	74F373	4.29
74F64	.89	74F244	3.29	74F374	4.29

NEW ADDRESS!

Visit our retail store located at 1256 S. Bascom Ave. in San Jose, (408) 947-8881

JDR Microdevices

110 Knowles Drive, Los Gatos, CA 95030

Toll Free 800-538-5000 • (408) 866-6200

FAX (408) 378-8927 • Telex 171-110

PLEASE USE YOUR CUSTOMER NUMBER WHEN ORDERING

TERMS: Minimum order $10.00. For shipping and handling include $2.50 for UPS Ground and $3.50 for UPS Air. Orders over 1 lb. and foreign orders may require additional shipping charges - please contact our sales department for the amount. CA residents must include applicable sales tax. All merchandise is warranted for 90 days unless otherwise stated. Prices are subject to change without notice. We are not responsible for typographical errors. We reserve the right to limit quantities and to substitute manufacturer. All merchandise subject to prior sale.

COPYRIGHT 1987 JDR MICRODEVICES Inquiry 152

THE JDR MICRODEVICES LOGO IS A REGISTERED TRADEMARK OF JDR MICRODEVICES. JDR INSTRUMENTS AND JDR MICRODEVICES ARE TRADEMARKS OF JDR MICRODEVICES.
IBM IS A TRADEMARK OF INTERNATIONAL BUSINESS MACHINES. APPLE IS A TRADEMARK OF APPLE COMPUTER

2400 BAUD MODEM FOR IBM WITH PC TALK III SOFTWARE $259!

CMOS

4001	.19	14419	4.95
4011	.19	14433	14.95
4012	.25	4503	.49
4013	.35	4511	.69
4015	.29	4516	.79
4016	.29	4518	.85
4017	.49	4522	.79
4018	.69	4526	.79
4020	.59	4527	1.95
4021	.69	4528	.79
4024	.49	4529	2.95
4025	.25	4532	1.95
4027	.39	4538	.95
4028	.65	4541	1.29
4035	.69	4553	5.79
4040	.69	4585	.75
4041	.75	4702	12.95
4042	.59	74C00	.29
4043	.85	74C14	.59
4044	.69	74C74	.59
4045	1.98	74C83	1.95
4046	.69	74C85	1.49
4047	.69	74C95	.99
4049	.29	74C150	5.75
4050	.29	74C151	2.25
4051	.69	74C161	.99
4052	.69	74C163	.99
4053	.69	74C164	1.39
4056	2.19	74C192	1.49
4060	.69	74C193	1.49
4066	.29	74C221	2.49
4069	.19	74C240	1.89
4076	.59	74C244	1.89
4077	.29	74C374	1.99
4081	.22	74C905	10.95
4085	.79	74C911	8.95
4086	.89	74C917	12.95
4093	.49	74C922	4.49
4094	2.49	74C923	4.95
14411	9.95	74C926	7.95
14412	6.95	80C97	.95

7400/9000

7400	.19	74147	2.49
7402	.19	74148	1.20
7404	.19	74150	1.35
7406	.29	74151	.55
7407	.29	74153	.55
7408	.24	74154	1.49
7410	.19	74155	.75
7411	.25	74157	.55
7414	.49	74159	1.65
7416	.25	74161	.69
7417	.25	74163	.69
7420	.19	74164	.85
7423	.29	74165	.85
7430	.19	74166	1.00
7432	.29	74175	.89
7438	.29	74177	.75
7442	.49	74178	1.15
7445	.69	74181	2.25
7447	.89	74182	.75
7470	.35	74184	2.00
7473	.34	74191	1.15
7474	.33	74192	.79
7475	.45	74194	.85
7476	.35	74196	.79
7483	.50	74197	.75
7485	.59	74199	1.35
7486	.35	74221	1.35
7489	2.15	74246	1.35
7490	.39	74247	1.25
7492	.50	74248	1.85
7493	.35	74249	1.95
7495	.55	74251	.75
7497	2.75	74265	1.35
74100	2.29	74273	1.95
74121	.29	74278	3.11
74123	.49	74367	.65
74125	.45	74368	.65
74141	.65	9368	3.95
74143	5.95	9602	1.50
74144	2.95	9637	2.95
74145	.60	96S02	1.95

74S00

74S00	.29	74S163	1.29
74S02	.29	74S168	3.95
74S03	.29	74S174	.79
74S04	.29	74S175	.79
74S05	.29	74S188	1.95
74S08	.35	74S189	1.95
74S10	.29	74S195	1.49
74S15	.49	74S196	2.49
74S30	.29	74S197	2.95
74S32	.35	74S226	3.99
74S37	.69	74S240	1.49
74S38	.69	74S241	1.49
74S74	.49	74S244	1.49
74S85	.95	74S257	.79
74S86	.35	74S253	.79
74S112	.50	74S258	.95
74S124	2.75	74S280	1.95
74S138	.79	74S287	1.69
74S140	.55	74S288	1.69
74S151	.79	74S299	2.95
74S153	.79	74S373	1.69
74S157	.79	74S374	1.69
74S158	.95	74S471	4.95
74S161	1.29	74S571	2.95

DATA ACQ INTERFACE

ADC0800	15.55	8T26	1.29
ADC0804	3.49	8T28	1.29
ADC0809	4.49	8T95	.89
ADC0816	14.95	8T96	.89
ADC0817	9.95	8T97	.59
ADC0831	8.95	8T98	.89
DAC0800	4.49	DM8131	2.95
DAC0806	1.95	DP8304	2.29
DAC0808	2.95	DS8833	2.25
DAC1020	8.25	DS8835	1.99
DAC1022	5.95	DS8836	.99
MC1408L8	2.95	DS8837	1.65

VOLTAGE REGULATORS

TO-220 CASE

7805T	.49	7905T	.59
7808T	.49	7908T	.59
7812T	.49	7912T	.59
7815T	.49	7915T	.59

TO-3 CASE

7805K	1.59	7905K	1.69
7812K	1.39	7912K	1.49

TO-93 CASE

78L05	.49	79L05	.69
78L12	.49	79L12	1.49

OTHER VOLTAGE REGS

LM323K	5V 3A TO-3		4.79
LM338K	Adj. 5A TO-3		6.95
78H12K	12V 5A TO-3		8.95

IC SOCKETS

	1-99	100+
8 PIN ST	.11	.10
14 PIN ST	.11	.09
16 PIN ST	.12	.10
18 PIN ST	.15	.13
20 PIN ST	.18	.15
22 PIN ST	.15	.12
24 PIN ST	.20	.15
28 PIN ST	.22	.16
40 PIN ST	.30	.22
64 PIN ST	1.95	1.49
ST=SOLDERTAIL		
8 PIN WW	.59	.69
14 PIN WW	.69	.52
16 PIN WW	.69	.58
18 PIN WW	.99	.90
20 PIN WW	1.09	.98
22 PIN WW	1.39	1.28
24 PIN WW	1.49	1.35
28 PIN WW	1.69	1.49
40 PIN WW	1.99	1.80
WW=WIREWRAP		
16 PIN ZIF	4.95	CALL
24 PIN ZIF	5.95	CALL
28 PIN ZIF	6.95	CALL
40 PIN ZIF	9.95	CALL

ZIF=TEXTOOL
(ZERO INSERTION FORCE)

LINEAR

TL066	.99	LM733	.98
TL071	.69	LM741	.29
TL072	1.09	LM747	.69
TL074	1.95	LM748	.59
TL081	.59	MC1330	1.69
TL082	.99	MC1350	1.19
TL084	1.49	MC1372	6.95
LM301	.34	LM1414	1.59
LM309K	1.25	LM1458	.49
LM311	.59	LM1488	.49
LM311H	.89	LM1489	.49
LM317K	3.49	LM1496	.85
LM317T	.95	LM1812	8.25
LM318	1.49	LM1889	1.95
LM319	1.25	ULN2003	.79
LM320	see7900	XR2206	3.95
LM322	1.95	XR2211	2.95
LM323K	4.79	XR2240	1.95
LM324	.49	MPQ2907	1.95
LM331	3.95	LM2917	1.95
LM334	1.19	CA3046	.89
LM335	1.79	CA3081	.99
LM336	1.75	CA3082	.99
LM337K	3.95	CA3086	.80
LM338K	6.95	CA3089	1.95
LM339	.59	CA3130E	.99
LM340	see7800	CA3146	1.29
LM350T	4.60	CA3160	1.19
LF353	.59	MC3470	1.95
LF356	.99	MC3480	8.95
LF357	.99	MC3487	2.95
LM358	.59	LM3900	.49
LM380	.89	LM3909	.98
LM383	1.95	LM3911	2.25
LM386	.89	LM3914	2.39
LM393	.45	MC4024	3.49
LM394H	5.95	MC4044	3.99
TL494	4.20	RC4136	1.25
TL497	3.25	RC4558	.69
NE555	.29	LM13600	1.49
NE556	.49	75107	1.49
NE558	1.29	75110	1.95
NE564	1.95	75150	1.95
LM565	.95	75154	1.95
LM566	1.49	75188	1.25
LM567	.79	75189	1.25
NE570	2.95	75451	.39
NE590	2.50	75452	.39
NE592	.98	75453	.39
LM710	.75	75477	1.29
LM723	.49	75492	.79

H=TO-5 CAN, K=TO-3, T=TO-220

EDGECARD CONNECTORS

100 PIN ST	S-100	.125	3.95
100 PIN WW	S-100	.125	4.95
62 PIN ST	IBM PC	.100	1.95
50 PIN ST	APPLE	.100	2.95
44 PIN ST	STD	.156	1.95
44 PIN WW	STD	.156	4.95

36 PIN CENTRONICS

MALE

IDCEN36	RIBBON CABLE	6.95
CEN36	SOLDER CUP	4.95

FEMALE

IDCEN36/F	RIBBON CABLE	7.95
CEN36PC	RT ANGLE PC MOUNT	4.95

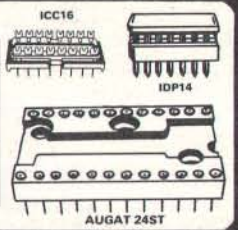
INTERSIL

ICL7106	9.95
ICL7107	12.95
ICL7660	2.95
ICL8038	4.95
ICM7207A	5.95
ICM7208	15.95

DIP CONNECTORS

DESCRIPTION	ORDER BY	CONTACTS 8	14	16	18	20	22	24	28	40
HIGH RELIABILITY TOOLED ST IC SOCKETS	AUGATxxST	.62	.79	.89	1.09	1.29	1.39	1.49	1.69	2.49
HIGH RELIABILITY TOOLED WW IC SOCKETS	AUGATxxWW	1.30	1.80	2.10	2.40	2.50	2.90	3.15	3.70	5.40
COMPONENT CARRIES (DIP HEADERS)	ICCxx	.49	.59	.69	.99	.99	.99	.99	1.09	1.49
RIBBON CABLE DIP PLUGS (IDC)	IDPxx	---	.95	.95	---	---	---	1.75	---	2.95

FOR ORDERING INSTRUCTIONS SEE D-SUBMINIATURE BELOW



DIODES/OPTO/TRANSISTORS

1N751	.25	4N26	.69
1N759	.25	4N27	.69
1N4148	25/1.00	4N28	.69
1N4004	10/1.00	4N33	.89
1N5402	.25	4N37	1.19
KBP02	.55	MCT-2	.59
KBU8A	.95	MCT-6	1.29
MDA990-2	.35	TIL-111	.99
N2222	.25	2N3906	.10
PN2222	.10	2N4401	.25
2N2905	.50	2N4402	.25
2N2907	.25	2N4403	.25
2N3055	.79	2N6045	1.75
2N3904	.10	TIP31	.49

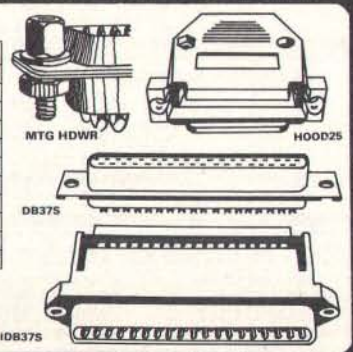
D-SUBMINIATURE

DESCRIPTION		ORDER BY	CONTACTS 9	15	19	25	37	50
SOLDER CUP	MALE	DBxxP	.82	.90	1.25	1.25	1.80	3.48
	FEMALE	DBxxS	.95	1.15	1.50	1.50	2.35	4.32
RIGHT ANGLE PC SOLDER	MALE	DBxxPR	1.20	1.49	---	1.95	2.65	---
	FEMALE	DBxxSR	1.25	1.55	---	2.00	2.79	---
WIRE WRAP	MALE	DBxxPWW	1.69	2.56	---	3.89	5.60	---
	FEMALE	DBxxSWW	2.76	4.27	---	6.84	9.95	---
IDC RIBBON CABLE	MALE	IDBxxP	2.70	2.95	---	3.98	5.70	---
	FEMALE	IDBxxS	2.92	3.20	---	4.33	6.76	---
HOODS	METAL	MHOODxx	1.25	1.25	1.30	1.3	---	---
	GREY	HOODxx	.65	.65	---	.6	.75	.95

ORDERING INSTRUCTIONS: INSERT THE NUMBER OF CONTACTS IN TH POSITION MARKED "xx" OF THE "ORDER BY" PART NUMBER LISTED.

EXAMPLE: A 15 PIN RIGHT ANGLE MALE PC SOLDER WOULD BE DB15I R.

MOUNTING HARDWARE $1.00



LED DISPLAYS

FND-357(359)	COM CATHODE .362"	1.25
FND-500(503)	COM CATHODE .5"	1.49
FND-507(510)	COM ANODE .5"	1.49
MAN-72	COM ANODE .3"	.99
MAN-74	COM CATHODE .3"	.99
MAN-8940	COM CATHODE .8"	1.99
TIL-313	COM CATHODE .3"	.45
TIL-311	4x7 HEX W/LOGIC .270"	9.95

DIFFUSED LEDS

		1-99	100-UP
JUMBO RED	T1¾	.10	.09
JUMBO GREEN	T1¾	.14	.12
JUMBO YELLOW	T1¾	.14	.12
MOUNTING HDW	T1¾	.10	.09
MINI RED	T1	.10	.09

SWITCHES

SPDT	MINI-TOGGLE ON-ON	1.25
DPDT	MINI-TOGGLE ON-ON	1.50
DPDT	MINI-TOGGLE ON-OFF-ON	1.75
SPST	MINI-PUSHBUTTON N.O.	.39
SPST	MINI-PUSHBUTTON N.C.	.39
BCD OUTPUT 10 POSITION 6 PIN DIP		1.95

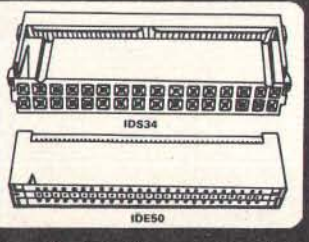
DIP SWITCHES

4 POSITION	.85	7 POSITION	.95
5 POSITION	.90	8 POSITION	.95
6 POSITION	.90	10 POSITION	1.29

IDC CONNECTORS

DESCRIPTION	ORDER BY	CONTACTS 10	20	26	34	40	50
SOLDER HEADER	IDHxxS	.82	1.29	1.68	2.20	2.58	3.24
RIGHT ANGLE SOLDER HEADER	IDHxxSR	.85	1.35	1.76	2.31	2.72	3.39
WW HEADER	IDHxxW	1.86	2.98	3.84	4.50	5.28	6.63
RIGHT ANGLE WW HEADER	IDHxxWR	2.05	3.28	4.22	4.45	4.80	7.30
RIBBON HEADER SOCKET	IDSxx	.79	.99	1.39	1.59	1.99	2.25
RIBBON HEADER	IDMxx	---	5.50	6.25	7.00	7.50	8.50
RIBBON EDGE CARD	IDExx	1.75	2.25	2.65	2.75	3.80	3.95

FOR ORDERING INSTRUCTIONS SEE D-SUBMINIATURE ABOVE



RIBBON CABLE

CONTACTS	SINGLE COLOR 1'	10'	COLOR CODED 1'	10'
10	.18	1.60	.30	2.75
16	.28	2.50	.48	4.40
20	.36	3.20	.60	5.50
25	.45	4.00	.75	6.85
26	.46	4.10	.78	7.15
34	.61	5.40	1.07	9.35
40	.72	6.40	1.20	11.00
50	.89	7.50	1.50	13.25

HARD TO FIND "SNAPABLE" HEADERS

CAN BE SNAPPED APART TO MAKE ANY SIZE HEADER, ALL WITH .1" CENTERS

1x40	STRAIGHT LEAD	.99
1x40	RIGHT ANGLE	1.49
2x40	STRAIGHT LEAD	2.49
2x40	RIGHT ANGLE	2.99

SHORTING BLOCKS

GOLD CONTACTS SPACED AT .1" CENTERS



5/$1.00

As a highly satisfied customer, I wish to praise the speedy and efficient ways in which my previous orders were handled. The quality of your merchandise is excellent and the prices are set to suit my budget. I have already reccomended your company to many of my colleagues and associates.

Lloyd Lynch

CALL FOR VOLUME QUOTES

COPYRIGHT 1987 JDR MICRODEVICES

1200 BAUD MODEM FOR IBM WITH PC TALK III SOFTWARE $109.95

BARGAIN HUNTERS CORNER

KEY TRONIC™ $49.95
5150 STYLE OEM KEYBOARD
- ★ IMPROVED KEYBOARD LAYOUT
- ★ 83 KEYS, FULLY IBM COMPATIBLE
- ★ LED INDICATORS FOR CAPS & NUMBER LOCK

MITSUBISHI $129.95
HIGH DENSITY DRIVE
- ★ IBM PC/AT COMPATIBLE
- ★ 1.2 MEGABYTE, ½ HEIGHT FDD
- ★ READS DS/DD OR DS/DH DISKETTES
- ★ QUIET & RELIABLE

SPECIALS ENDS 4/30/87

PAGE WIRE WRAP WIRE
PRECUT ASSORTMENT
IN ASSORTED COLORS $27.50
100ea: 5.5", 6.0", 6.5", 7.0"
250ea: 2.5", 4.5", 5.0"
500ea: 3.0", 3.5", 4.0"

SPOOLS

100 feet	$4.30	250 feet	$7.25
500 feet	$13.25	1000 feet	$21.95

Please specify color:
Blue, Black, Yellow or Red

EMI FILTER $4.95
- MANUFACTURED BY CORCOM
- LOW COST
- FITS LC-HP BELOW
- 6 AMP 120/240 VOLT



6 FOOT LINE CORDS

LC-2	2 CONDUCTOR	.39
LC-3	3 CONDUCTOR	.99
LC-HP	3 CONDUCTOR W/STD FEMALE SOCKET	1.49

MUFFIN FANS

3.15" SQ.	ROTRON	14.95
3.63" SQ.	ETRI	14.95
3.18" SQ.	PAPST	16.95

WIRE WRAP PROTOTYPE CARDS
FR-4 EPOXY GLASS LAMINATE
WITH GOLD-PLATED EDGE-CARD FINGERS



IBM-PR2

IBM
BOTH CARDS HAVE SILK SCREENED LEGENDS AND INCLUDES MOUNTING BRACKET

IBM-PR1	WITH +5V AND GROUND PLANE	$27.95
IBM-PR2	AS ABOVE WITH DECODING LAYOUT	$29.95

S-100

P100-1	BARE - NO FOIL PADS	$15.15
P100-2	HORIZONTAL BUS	$21.80
P100-3	VERTICAL BUS	$21.80
P100-4	SINGLE FOIL PADS PER HOLE	$22.75

APPLE

P500-1	BARE - NO FOIL PADS	$15.15
P500-3	HORIZONTAL BUS	$22.75
P500-4	SINGLE FOIL PADS PER HOLE	$21.80
7060-45	FOR APPLE IIe AUX SLOT	$30.00

SOCKET-WRAP I.D.™
- SLIPS OVER WIRE WRAP PINS
- IDENTIFIES PIN NUMBERS ON WRAP SIDE OF BOARD
- CAN WRITE ON PLASTIC; SUCH AS IC #

PINS	PART#	PCK. OF	PRICE
8	IDWRAP 08	10	1.95
14	IDWRAP 14	10	1.95
16	IDWRAP 16	10	1.95
18	IDWRAP 18	5	1.95
20	IDWRAP 20	5	1.95
22	IDWRAP 22	5	1.95
24	IDWRAP 24	5	1.95
28	IDWRAP 28	5	1.95
40	IDWRAP 40	5	1.95

PLEASE ORDER BY NUMBER OF PACKAGES (PCK. OF)



ID WRAP 24

FRAME STYLE TRANSFORMERS

12.6V AC CT	2 AMP	5.95
12.6V AC CT	4 AMP	7.95
12.6V AC CT	8 AMP	10.95
25.2V AC CT	2 AMP	7.95

25 PIN D-SUB GENDER CHANGERS $7.95



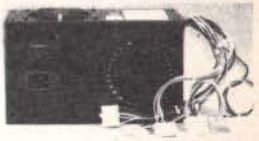
SWITCHING POWER SUPPLIES

PS-IBM $69.95
- FOR IBM PC-XT COMPATIBLE
- 135 WATTS
- +5V @ 15A, +12V @ 4.2A -5V @ .5A, -12V @ .5A
- ONE YEAR WARRANTY



PS-IBM/150

PS-IBM-150 $79.95
- FOR IBM PC-XT COMPATIBLE
- 150 WATTS
- +12V @ 5.2A, +5V @ 16A -12V @ .5A, -5V @ .5A
- ONE YEAR WARRANTY



PS-130

PS-130 $99.95
- 130 WATTS
- SWITCH ON REAR
- FOR USE IN OTHER IBM TYPE MACHINES
- 90 DAY WARRANTY



PS-A

PS-A $49.95
- USE TO POWER APPLE TYPE SYSTEMS, 79.5 WATTS
- +5V @ 7A, +12V @ 3A -5V @ .5A, -12V @ .5A
- APPLE POWER CONNECTOR



PS-1558 $34.95
- 75 WATTS, UL APPROVED
- +5V @ 7A, +12V @ 3A -12V @ 250ma, -5V @ 300ma

PS-1558

CAPACITORS

TANTALUM

1.0µf	15V	.35	.47µf	35V	.45
6.8	15V	.70	1.0	35V	.45
10	15V	.80	2.2	35V	.65
22	15V	1.35	4.7	35V	.85
.22	35V	.40	10	35V	1.00

DISC

10pf	50V	.05	680	50V	.05
22	50V	.05	.001µf	50V	.05
27	50V	.05	.0022	50V	.05
33	50V	.05	.005	50V	.05
47	50V	.05	.01	50V	.07
68	50V	.05	.02	50V	.07
100	50V	.05	.05	50V	.07
220	50V	.05	.1	12V	.10
560	50V	.05	.1	50V	.12

MONOLITHIC

.01µf	50V	.14	.1µf	50V	.18
.047µf	50V	.15	.47µf	50V	.25

ELECTROLYTIC

RADIAL			AXIAL		
1µf	25V	.14	1µf	50V	.14
2.2	35V	.15	10	50V	.16
4.7	50V	.15	22	16V	.14
10	50V	.15	47	50V	.20
47	35V	.18	100	35V	.25
100	16V	.18	220	25V	.30
220	35V	.20	470	50V	.50
470	25V	.30	1000	16V	.60
2200	16V	.70	2200	16V	.70
4700	25V	1.45	4700	16V	1.25

DATARASE EPROM ERASER $34.95
- ERASES 2 IN 10 MINUTES
- COMPACT-NO DRAWER
- THIN METAL SHUTTER PREVENTS UV LIGHT FROM ESCAPING



¼ WATT RESISTORS
5% CARBON FILM ALL STANDARD VALUES FROM 1 OHM TO 10 MEG. OHM

10 PCS	same value .05	100 PCS	same value .02
50 PCS	same value .025	1000 PCS	same value .015

RESISTOR NETWORKS

SIP	10 PIN	9 RESISTOR	.69
SIP	8 PIN	7 RESISTOR	.59
DIP	16 PIN	8 RESISTOR	1.09
DIP	16 PIN	15 RESISTOR	1.09
DIP	14 PIN	7 RESISTOR	.99
DIP	14 PIN	13 RESISTOR	.99

SPECIALS ON BYPASS CAPACITORS

.01 µf CERAMIC DISC	100/$5.00
.01 µf MONOLITHIC	100/$10.00
.1 µf CERAMIC DISC	100/$6.50
.1 µf MONOLITHIC	100/$12.50

BOOKS BY STEVE CIARCIA

BIULD YOUR OWN Z80 COMPUTER	$19.95
CIRCUIT CELLAR VOL 1	$17.95
CIRCUIT CELLAR VOL 2	$18.95
CIRCUIT CELLAR VOL 3	$18.95
CIRCUIT CELLAR VOL 4	$18.95
CIRCUIT CELLAR VOL 5	$19.95

MICROCOMPUTER HARDWARE HANDBOOK FROM ELCOMP $14.95
OVER 800 PAGES OF DATA SHEETS ON THE MOST COMMONLY USED ICs. INCLUDES TTL, CMOS, 74LS00, MEMORY, CPUs, MPU SUPPORT. AND MUCH MORE!

WISH SOLDERLESS BREADBOARDS

PART NUMBER	DIMENSIONS	DISTRIBUTION STRIP(S)	TIE POINTS	TERMINAL STRIP(S)	TIE POINTS	BINDING POSTS	PRICE
WBU-D	.38 x 6.50"	1	100	---	---	---	2.95
WBU-T	1.38 x 6.50"	---	---	1	630	---	6.95
WBU-204-3	3.94 x 8.45"	1	100	2	1260	2	17.95
WBU-204	5.13 x 8.45"	4	400	2	1260	3	24.95
WBU-206	6.88 x 9.06"	5	500	3	1890	4	29.95
WBU-208	8.25 x 9.45"	7	700	4	2520	4	39.95



WBU-208

LITHIUM BATTERY
AS USED IN CLOCK CIRCUITS



3 VOLT BATTERY	$3.95
BATTERY HOLDER	$1.49

2 VOLUME SET
1986 IC MASTER
THE INDUSTRY STANDARD
$129.95

NEW ADDRESS!

Visit our retail store located at 1256 S. Bascom Ave. in San Jose, (408) 947-8881

JDR Microdevices
110 Knowles Drive, Los Gatos, CA 95030
Toll Free 800-538-5000 • (408) 866-6200
FAX (408) 378-8927 • Telex 171-110

PLEASE USE YOUR CUSTOMER NUMBER WHEN ORDERING

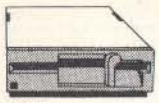
TERMS: Minimum order $10.00. For shipping and handling include $2.50 for UPS Ground and $3.50 for UPS Air. Orders over 1 lb. and foreign orders may require additional shipping charges - please contact our sales department for the amount. CA residents must include applicable sales tax. All merchandise is warranted for 90 days unless otherwise stated. Prices are subject to change without notice. We are not responsible for typographical errors. We reserve the right to limit quantities and to substitute manufacturer. All merchandise subject to prior sale.

COPYRIGHT 1987 JDR MICRODEVICES Inquiry 153

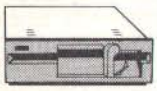
THE JDR MICRODEVICES LOGO IS A REGISTERED TRADEMARK OF JDR MICRODEVICES. JDR INSTRUMENTS AND JDR MICRODEVICES ARE TRADEMARKS OF JDR MICRODEVICES
IBM IS A TRADEMARK OF INTERNATIONAL BUSINESS MACHINES. APPLE IS A TRADEMARK OF APPLE COMPUTER.

2400 BAUD MODEM FOR IBM WITH PC TALK III SOFTWARE $259!

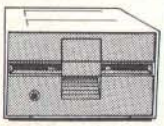
DISK DRIVES
FOR APPLE COMPUTERS



AP-150 $99.95
- ½ HT, DIRECT DRIVE
- 100% APPLE COMPATIBLE
- SIX MONTH WARRANTY

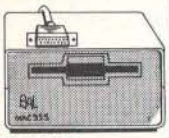


BAL-500 $129.95
- TEAC MECHANISM-DIRECT DRIVE
- 100% APPLE COMPATIBLE
- FULL ONE YEAR WARRANTY

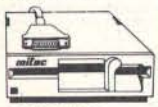


AP-135 $129.95
- FULL HT SHUGART MECHANISM
- DIRECT REPLACEMENT FOR APPLE DISK II
- SIX MONTH WARRANTY

DOUBLE SIDED!



MAC535 $249.95
- 3.5" ADD-ON DISK DRIVE
- 100% MACINTOSH COMPATABLE
- DOUBLE SIDED 800K BYTE STORAGE
- HIGH RELIABILITY DRIVE HAS AUTO-EJECT MECHANISM
- FULL ONE YEAR WARRANTY



AD-3C $139.95
- 100% APPLE IIc COMPATIBLE, READY TO PLUG IN, W/SHIELDED CABLE & MOLDED 19 PIN CONNECTOR
- FAST, RELIABLE SLIMLINE DIRECT DRIVE
- SIX MONTH WARRANTY

DISK DRIVE ACCESSORIES
FDD CONTROLLER CARD $49.95
IIc ADAPTOR CABLE $19.95
ADAPTS STANDARD APPLE DRIVES FOR USE WITH APPLE IIc

KB-1000 $79.95
CASE WITH KEYBOARD FOR APPLE TYPE MOTHERBOARD
- USER DEFINED FUNCTION KEYS
- NUMERIC KEYPAD WITH CURSOR CONTROL
- CAPS LOCK
- AUTO-REPEAT



KEYBOARD-AP $49.95
- REPLACEMENT FOR APPLE II KEYBOARD
- CAPS LOCK KEY, AUTO-REPEAT
- ONE KEY ENTRY OF BASIC OR CP/M COMMANDS



EXTENDER CARDS

IBM-PC	$45.00
IBM-AT	$68.00
APPLE II	$45.00
APPLE IIe	$45.00
MULTIBUS	$86.00

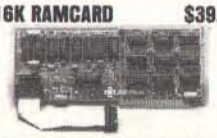
APPLE COMPATIBLE INTERFACE CARDS

EPROM PROGRAMMER $59.95
MODEL RP525



- DUPLICATE OR BURN ANY STANDARD 27xx SERIES EPROM
- EASY TO USE MENU-DRIVEN SOFTWARE IS INCLUDED
- MENU SELECTION FOR 2716, 2732, 2732A, 2764 AND 27128
- HIGH SPEED WRITE ALGORITHM
- LED INDICATORS FOR ACTIVITY
- NO EXTERNAL POWER SUPPLY NEEDED
- ONE YEAR WARRANTY

16K RAMCARD $39.95



- FULL TWO YEAR WARRANTY
- EXPAND YOUR 48K APPLE TO 64K
- USE IN PLACE OF APPLE LANGUAGE CARD

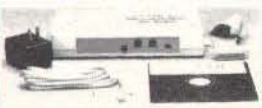
BARE PC CARD W/INSTRUCTIONS $8.95

IC TEST CARD $99.95



- QUICKLY TESTS MANY COMMON ICs
- DISPLAYS PASS OR FAIL
- ONE YEAR WARRANTY
- TESTS: 4000 SERIES CMOS, 74HC SERIES CMOS, 7400, 74LS, 74L, 74H & 74S

300B MODEM $49.95
FOR APPLE OR IBM
INCLUDES ASCII PRO-EZ SOFTWARE



- FCC APPROVED
- BELL SYSTEMS 103 COMPATIBLE
- INCLUDES AC ADAPTOR
- AUTO-DIAL
- DIRECT CONNECT

CABLE FOR APPLE IIc $14.95

JOYSTICK CR-401 $7.95
FOR ATARI 400, 800, 2600, VIC 20/64 AND APPLE IIe

DISKFILE
HOLDS 70 5¼" DISKETTES

$89.95



3.5" DISKFILE HOLDS 40 $99.95

POWER STRIP
- UL APPROVED
- 15A CIRCUIT BREAKER

$12.95



2 WAY SWITCH BOXES
- AVAILABLE IN SERIAL OR PARALLEL
- CONNECTS 2 PRINTERS TO ONE COMPUTER OR VICE VERSA
- ALL LINES SWITCHES
- PUSH-BUTTON SWITCHES MOUNTED ON PCB
- 3 FEMALE GOLD-PLATED CONNECTORS

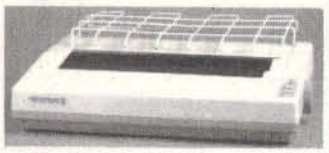


AB-P CENTRONICS PARALLEL	$39.95
AB-S RS232 SERIAL	$39.95

MOLDED INTERFACE CABLES
6 FOOT, 100% SHIELDED, MEETS FCC

IBM PARALLEL PRINTER CABLE	9.95
CENTRONICS MALE TO FEMALE	15.95
CENTRONICS MALE TO MALE	14.95
MODEM CABLE FOR IBM	7.95
RS232 SERIAL MALE TO FEMALE	9.95
RS232 SERIAL MALE TO MALE	9.95
KEYBOARD EXTENSION (COILED)	7.95
APPLE II JOYSTICK EXTENSION	4.95

C. ITOH RITEMAN II PRINTER



- 160 CPS DRAFT MODE, 32 CPS NLQ MODE
- 9 x 9 DOT MATRIX
- SUPPORTS EPSON/IBM GRAPHICS
- FRICTION AND PIN FEEDS
- VARIABLE LINE SPACING AND PITCH

$219.95

IBM PRINTER CABLE	$9.95
REPLACEMENT RIBBON CARTRIDGE	$7.95

NASHUA DISKETTES DEALS
5¼" SOFT SECTOR DS/DD WITH HUB RINGS

$9.90	69¢ea	59¢ea
BOX OF 10	BULK QTY 50	BULK QTY 250

NASHUA DISKETTES WERE JUDGED TO HAVE THE HIGHEST POLISH AND RECORDED AMPLITUDE OF ANY DISKETTES TESTED ACCORDING TO "COMPARING FLOPPY DISKS", BYTE 9/84

DISKETTES

NASHUA 5¼"

N-MD2D	DS/DD SOFT	$9.90
N-MD2F	DS/QUAD SOFT	$19.95
N-MD2H	DS/HD FOR AT	$24.95

NASHUA 8"

N-FD1	SS/DD SOFT	$27.95
N-FD2D	DS/DD SOFT	$34.95

NASHUA 3.5"

N-3.5SS	3.5" SS/DD FOR MAC	$24.95

VERBATIM 5¼"

V-MD1D	SS/DD SOFT	$16.95
V-MD2D	DS/DD SOFT	$17.95
V-MD110D	SS/DD 10 SECTOR HARD	$19.95

BUILD STEVE CIARCIA'S INTELLIGENT EPROM PROGRAMMER
AS SEEN IN BYTE, OCT. 86
- STAND-ALONE OR RS-232 SERIAL OPERATION
- MENU SELECTABLE EPROM TYPES—NO CONFIGURATION JUMPERS
- PROGRAMS ALL 5V 27XXX EPROMS FROM 2716 TO 27512
- READ, COPY OR VERIFY EPROM
- UPLOAD/DOWNLOAD INTEL HEX FILES
- PROGRAMMER DRIVER USER MODIFIABLE

ONLY $199

KIT INCLUDES PCB AND ALL COMPONENTS EXCEPT CASE AND POWER SUPPLY

5¼" FLOPPY DISK DRIVES

TEAC FD-55B	½ HT DS/DD (FOR IBM)	$109.95
TEAC FD-55F	½ HT DS/QUAD (FOR IBM)	$124.95
TEAC FD-55GFV	½ HT DS/HD (FOR IBM AT)	$154.95
TANDON TM100-2	DS/DD (FOR IBM)	$119.00
TANDON TM50-2	½ HT DS/DD (FOR IBM)	$79.95
MPI-852	DS/DD (FOR IBM)	$79.95

8" FLOPPY DISK DRIVES

FD 100-8	SS/DD (SA/801 EQUIV)	$119.00
FD 200-8	DS/DD (SA/851R EQUIV)	$159.00

DISK DRIVE ACCESSORIES

TEAC SPECIFICATION MANUAL	$5.00
TEAC MAINTENANCE MANUAL	$25.00
½ HT MOUNTING HARDWARE	$2.95
MOUNTING RAILS FOR IBM AT	$4.95
"Y" POWER CABLE FOR 5¼" FDDs	$2.95
5¼" FDD POWER CONNECTORS	$1.19



TEAC FD-55



TANDON TM100-2

DISK DRIVE ENCLOSURES

CAB-1FH5 $89.95
FULL HT 5¼" BEIGE CABINET W/POWER SUPPLY

CAB-2SV5 $49.95
DUAL SLIMLINE 5¼" CABINET W/POWER SUPPLY

CAB-2SV8 VERTICAL $209.95
DUAL SLIMLINE 8" CABINET W/POWER SUPPLY

CAB-2FH8 HORIZINTAL $219.95
DUAL FULL HT 8" CABINET W/POWER SUPPLY



CAB-2SV5



CAB-1FH5

TEST EQUIPMENT FROM JDR INSTRUMENTS

DIGITAL MULTIMETER PEN DPM-1000 $54.95
AUTO RANGING, POLARITY AND DECIMAL!
- LARGE 3.5 DIGIT DISPLAY
- DATA HOLD SWITCH FREEZES READING
- FAST, AUDIBLE CONTINUITY TEST
- LOW BATTERY INDICATOR
- OVERLOAD PROTECTION



20MHz DUAL TRACE OSCILLOSCOPE	MODEL 2000	$349.95
35MHz DUAL TRACE OSCILLOSCOPE	MODEL 3500	$499.95

FOR MORE INFORMATION ON THE OSCILLOSCOPES, CALL US FOR FREE PRODUCT BRIEFS.

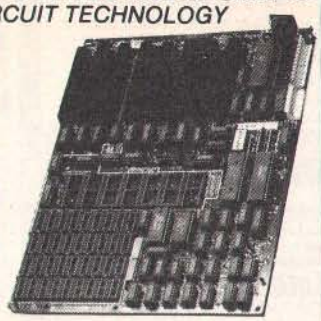
CALL FOR VOLUME QUOTES

COPYRIGHT 1987 JDR MICRODEVICES

1.2 MB MITSUBISHI DRIVE HALF HEIGHT FOR AT $129.95

QUALITY IBM COMPATIBLE MOTHERBOARDS

FROM MODULAR CIRCUIT TECHNOLOGY



TURBO 4.77 / 8 MHz $129.95

JDR PART #: MCT-TURBO

- 4.77 OR 8 MHz OPERATION WITH 8088-2 AND OPTIONAL 8087-2 CO-PROCESSOR
- DYNAMICALLY ADJUSTS SPEED DURING DISKETTE OPERATION FOR MAXIMUM THROUGHPUT AND RELIABILITY
- CHOICE OF NORMAL / TURBO MODE OR SOFTWARE SELECT PROCESSOR SPEED

STANDARD 4.77 MHz $109.95

JDR PART #: MCT-XTMB

- 8088 CPU, OPTIONAL 8087 CO-PROCESSOR
- 8 EXPANSION SLOTS
- 0K RAM INSTALLED, EXPANDABLE TO 640K ON-BOARD MEMORY
- ALL ICs SOCKETED-HIGHEST QUALITY PCB
- ACCEPTS 2764 OR 27128 ROMS

NOW WITH FREE MCT BIOS!

IBM COMPATIBLE INTERFACE CARDS

ALL WITH A ONE YEAR WARRANTY

MULTI I/O FLOPPY CARD $89.95

PERFECT FOR THE 640K MOTHERBOARD



- 2 DRIVE FLOPPY DISK CONTROLLER
- 1 RS232 SERIAL PORT; OPTIONAL 2nd SERIAL PORT
- PARALLEL PRINTER PORT
- GAME PORT
- CLOCK/CALENDAR
- SOFTWARE: CLOCK UTILITIES, RAMDISK, SPOOLER

OPTIONAL SERIAL PORT $15.95

MULTIFUNCTION CARD $79.95

ALL THE FEATURES OF AST'S 6 PACK PLUS AT HALF THE PRICE



- CLOCK/CALENDAR
- 0-384K RAM
- SERIAL PORT
- PARALLEL PORT
- GAME PORT
- SOFTWARE INCLUDED

PRINTER CABLE $9.95
64K RAM UPGRADE 9/$11.61

COLOR GRAPHICS ADAPTOR $69.95

FULLY COMPATIBLE WITH IBM COLOR CARD



- 4 VIDEO INTERFACES: RGB, COMPOSITE COLOR, HI-RES COMPOSITE MONOCHROME, CONNECTOR FOR RF MODULATOR
- COLOR GRAPHICS MODE: 320 x 200
- MONO GRAPHICS MODE: 640 x 200
- LIGHT PEN INTERFACE

MONOCHROME GRAPHICS CARD $79.95

FULLY COMPATIBLE W/IBM MONOCHROME ADAPTOR & HERCULES GRAPHICS



- LOTUS COMPATIBLE
- TEXT MODE: 80 x 25
- GRAPHICS MODE: 720 x 348
- PARALLEL PRINTER PORT; OPTIONAL SERIAL PORT
- STANDARD TTL COMPATIBLE OUTPUT

OPTIONAL SERIAL PORT $19.95

MONOCHROME ADAPTOR $49.95

ANOTHER FANTASTIC VALUE FROM JDR!

- IBM COMPATIBLE TTL OUTPUT
- 720 x 350 PIXEL DIPLAY

PLEASE NOTE: THIS CARD WILL NOT RUN LOTUS GRAPHICS AND DOES NOT INCLUDE A PARALLEL PORT

FLOPPY DISK DRIVE ADAPTOR $34.95



- INTERFACES UP TO 4 STANDARD FDDs TO IBM PC OR COMPATIBLES
- INCLUDES CABLE FOR TWO INTERNAL DRIVES
- STANDARD DB37 FOR EXTERNAL DRIVES
- RUNS QUAD DENSITY DRIVES WHEN USED WITH JFORMAT

1200 BAUD MODEMS BY EASYDATA

HAYES COMPATIBLE, AUTO-DIAL, AUTO-ANSWER, AUTO RE-DIAL ON BUSY, POWER-UP SELF TEST, FULL ONE YEAR WARRANTY

MODEL 1200B*	MODEL 1200H*	EASYDATA-12
• INTERNAL DESIGN	• INTERNAL DESIGN	• EXTERNAL DESIGN
• 10 INCH CARD	• HALF LENGTH (5") CARD	• WITH POWER SUPPLY
• SERIAL PORT INCLUDED	• INCLUDES SPEAKER	• LED STATUS INDICATORS
$119.95	$109.95	$119.95

*FOR IBM, INCLUDES PC TALK III COMMUNICATIONS SOFTWARE

CRT MONITORS FOR ALL APPLICATIONS



HITACHI RGB MONITOR

MODEL 1020

- MADE FOR ERICSSON BY HITACHI
- DIGITAL RGB-IBM COMPATIBLE
- 12" SCREEN
- RESOLUTION: 640H x 200V
- .38mm DOT PITCH
- CABLE FOR IBM PC INCLUDED

$289.95



SAMSUNG MONOCHROME

MODEL SM-12SF

- IBM COMPATIBLE TTL INPUT
- 12" NON-GLARE AMBER, LOW DISTORTION SCREEN
- RESOLUTION: 720H x 350V
- ATTRACTIVE CASE WITH SWIVEL BASE
- ONE YEAR WARRANTY

$119.95



CENTER SYSTEMS MONOCHROME

MODEL KLM-1211

- IBM COMPATIBLE TTL INPUT
- 12" NON-GLARE SCREEN
- VERY HIGH RESOLUTION: 1100 LINES (CENTER)
- 25 MHz BANDWIDTH
- CABLE FOR IBM PC INCLUDED

AMBER OR GREEN AVAILABLE

$99.95

ATTRACTIVE TILT & SWIVEL MONITOR STAND $12.95

HALF HEIGHT HARD DISK SYSTEMS

Includes half height hard disk drive, hard disk drive controller, cables and instructions. All drives are pre-tested and are backed with a full one year warranty.

10 MEGA BYTE HDD	MMI 212	$289.95
20 MEGA BYTE HDD	SEAGATE ST-225	$369.95

BUILD YOUR OWN 256K XT COMPATIBLE SYSTEM

XT MOTHERBOARD	$109.95
PRO-BIOS (A $20 VALUE)	FREE!
256K RAM	$26.55
130W POWER SUPPLY	$69.95
FLIP-TOP CASE	$39.95
MCT-5150 KEYBOARD	$59.95
½ HT TANDON DRIVE	$79.95
FDD CONTROLLER	$34.95
MONOCHROME ADAPTOR	$49.95
CENTER MONITOR	$99.95
TOTAL :	$571.15

IBM STYLE COMPUTER CASE

AN ATTRACTIVE STEEL CASE WITH A HINGED LID FITS THE POPULAR PC/XT COMPATIBLE MOTHERBOARDS



- SWITCH CUT-OUT ON SIDE FOR PC/XT STYLE POWER SUPPLY
- CUT-OUT FOR 8 EXPANSION SLOTS
- ALL HARDWARE INCLUDED

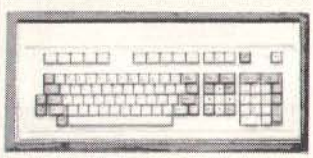
$39.95

IBM COMPATIBLE KEYBOARDS



MCT-5150 $59.95

- "5150" STYLE KEYBOARD
- FULLY IBM COMPATIBLE
- LED STATUS INDICATORS FOR CAPS & NUMBER LOCK
- LARGE, EASY TO REACH SHIFT & RETURN KEYS
- 83 KEY TYPEWRITER LAYOUT



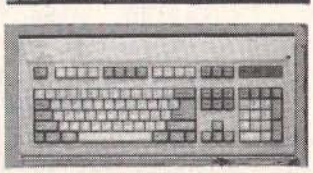
MCT-5151 $79.95

- REPLACEMENT FOR KEYTRONICS KB-5151™
- SEPARATE CURSOR & NUMERIC KEYPAD
- CAPS LOCK & NUMBER LOCK INDICATORS
- IMPROVED KEYBOARD LAYOUT



MCT-5060 $59.95

- IBM AT STYLE LAYOUT
- SOFTWARE AUTOSENSE FOR XT OR AT COMPATIBLES
- EXTRA LARGE SHIFT & RETURN KEYS
- LED INDICATORS FOR SCROLL, CAPS & NUMBER LOCK
- AUTO REPEAT FEATURE



MCT-5339 $89.95

- IBM ENHANCED STYLE LAYOUT
- SOFTWARE AUTOSENSE FOR XT OR AT COMPATIBLES
- 12 FUNCTION KEYS
- EXTRA LARGE SHIFT & RETURN KEYS
- LED INDICATORS FOR SCROLL, CAPS & NUMBER LOCK
- AUTO REPEAT FEATURE
- SEPARATE CURSOR PAD

JDR Microdevices Inquiry 154 110 Knowles Drive, Los Gatos, CA 95030
Toll Free 800-538-5000 • (408) 866-6200 • FAX (408) 378-8927 • Telex 171-110

COPYRIGHT 1987 JDR MICRODEVICES

1200 BAUD MODEM

FOR IBM WITH PC TALK III COMMUNICATIONS SOFTWARE

$109.95

EASYDATA 2400 BAUD INTERNAL MODEM

INCLUDES PC TALK III COMMUNICATIONS SOFTWARE!

- *AUTO-DIAL/ANSWER/REDIAL ON BUSY
- * TOUCH TONE OR PULSE DIAL
- * POWER-UP SELF TEST, BUILT-IN SPEAKER
- * HAYES COMPATIBLE "AT" COMMAND SET
- * BELL 103, 212A, CCITT V22 AND V22BIS COMPATIBLE, FULL OR HALF DUPLEX, FOR OPERATION AT 0-300, 1200 OR 2400 BITS/SEC.
- * SELECTABLE AS COM1 OR COM2 FROM AN EXTERNAL SWITCH
- * ONE YEAR WARRANTY

$259!

ENHANCED GRAPHICS ADAPTOR

100% IBM COMPATIBLE—PASSES IBM EGA DIAGNOSTICS

- * COMPATIBLE WITH IBM EGA, COLOR GRAPHICS ADAPTOR AND MONOCHROME ADAPTOR
- * DISPLAYS 16 COLORS OUT OF 64 COLORS
- * COMES WITH 256K OF VIDEO RAM
- * DUAL SCANNING FREQUENCIES WORKS WITH STANDARD OR EGA TYPE RGB MONITORS
- * LIGHT PEN INTERFACE

ONLY $199.95

EGA MONITOR

FULL ONE YEAR WARRANTY

- * EGA AND CGA COMPATIBLE
- * SCANNING FREQUENCIES: 15.75 KHz / 21.85 KHz
- * 14" BLACK MATRIX, NON-GLARE SCREEN
- * RESOLUTION: 640 x 200 / 640 x 350
- * .31 DOT, 25MHz
- * 16 COLORS OUT OF 64

$459.95



NOW BUY BOTH FOR $599!

20 MB HARD DISK SYSTEM

INCLUDES HARD DISK CONTROLLER, CABLES AND INSTRUCTIONS. ALL DRIVES ARE PRE-TESTED AND COME WITH A 1 YEAR WARRANTY.

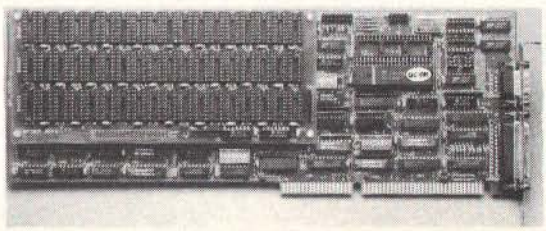
$369.95

AT MULTIFUNCTION CARD $159.95

ADDS UP TO 3 MEGABYTES OF USER EXPANDABLE MEMORY

- * SHIPPED WITH ZERO K RAM, USER EXPANDABLE TO 1.5 MEGABYTES RAM ON BOARD, UP TO 3 MEGABYTES WITH OPTIONAL PIGGYBACK CARD
- * USES 64K OR 256K DYNAMIC RAMS
- * PARALLEL PORT & GAME PORT
- * SERIAL PORT
- * OPTIONAL SECOND SERIAL PORT

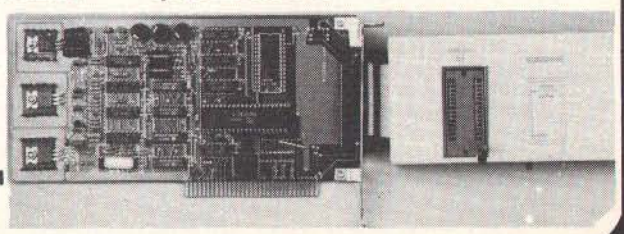
PIGGYBACK MEMORY CARD (NO MEMORY INSTALLED) $49.95



EPROM PROGRAMMER $129.95

FOR IBM PC/XT/AT AND COMPATIBLES

- * PROGRAMS 27xxx SERIES EPROMS UP TO 27512
- * MENU DRIVEN SOFTWARE PROVIDED ON DISKETTE
- * AUTOMATICALLY SETS PROGRAMMING VOLTAGE
- * LOADS AND SAVES EPROM BUFFER TO DISK
- * READ, WRITE, COPY, VERIFY OR CHECK BLANK
- * DEBUG STYLE EDITOR FOR EASY MODIFICATION OF PROGRAM
- * SPLITS OR COMBINES EPROMS OF DIFFERING SIZES
- * INTERNAL CARD WITH EXTERNAL CABLE FOR A ZIF SOCKET



JDR Microdevices

110 Knowles Drive, Los Gatos, CA 95030

Toll Free 800-538-5000 • (408) 866-6200 • FAX (408) 378-8927 • Telex 171-110

Inquiry 154

COPYRIGHT 1987 JDR MICRODEVICES

THE JDR MICRODEVICES LOGO IS A REGISTERED TRADEMARK OF JDR MICRODEVICES. JDR INSTRUMENTS AND JDR MICRODEVICES ARE TRADEMARKS OF JDR MICRODEVICES
IBM IS A TRADEMARK OF INTERNATIONAL BUSINESS MACHINES

BOMB

YOU CHOOSE THE BEST ARTICLE EACH MONTH

BYTE's ongoing monitor box (BOMB) lets you rate each article you've read in BYTE as excellent, good, fair, or poor. Each month, you can mail in the BOMB card found at the back of the issue. We tally your votes, total the points, and award the two top-rated nonstaff authors $100 and $50, respectively. An additional $50 award for quality goes to the nonstaff author with the best average score (total points divided by the number of voters). If you prefer, you can use BIX as your method of voting. We welcome your participation.

ARTICLE#	PAGE	ARTICLE	AUTHOR(S)
1	9	Microbytes	staff
2	29	What's New	staff
3	52	Ask BYTE/Circuit Cellar Feedback	Ciarcia
4	67	Book Reviews	Hoenig
5	84	Product Preview: The Commodore A2000	Williams, Thompson, Grehan
6	101	Product Preview: Turbo BASIC	Stewart
7	113	Ciarcia's Circuit Cellar: Build a Trainable Infrared Master Controller	Ciarcia
8	127	Programming Insight: Building a Random-Number Generator	Wichmann, Hill
9	129	Programming Project: Installing Memory-Resident Programs with C	Edginton
10	143	Probing Space by Camera	Sheldon
11	151	Digital Image Processing in Art Conservation	Asmus
12	169	Introduction to Image Processing Algorithms	Dawson
13	191	Low-Cost Image Processing	McManis
14	197	PreScript	Sheldon
15	209	A Trio of 8-MHz PC AT Compatibles	Miastkowski
16	215	AT&T's TrueVision Image Processing System	Tinney
17	217	Four Laser Printers	Little
18	223	PC Scheme: A Lexical LISP	Wong
19	226	Concurrent PC DOS	Rash
20	228	Wendin's Operating System Toolbox	Levitt
21	235	PFS: First Choice	Allen
22	237	WriteNow for the Macintosh	O'Neil
23	238	CAD-3D	DeMaria
24	251	Computing at Chaos Manor: The Curse of Chaos Manor	Pournelle
25	271	Applications Only: Status Report	Shapiro
26	279	BYTE U.K.: Taking Control	Pountain
27	291	According to Webster: Amiga Developers Conference	Webster
28	311	Best of BIX	BIXen

BOMB RESULTS

Top mention for December's BYTE, which is based on the quantity of votes received, goes to Steve Ciarcia for his Circuit Cellar project entitled "Build the GT180 Color Graphics Board, Part 2: Hardware." In second place is Stephen Satchell's evaluation of "23 Modems," for which Mr. Satchell wins $100. Winner of $50 for placing third is Kenneth E. Perry for "Abstract Mathematical Art." Monetary awards are given only to top-ranking authors who are not part of the BYTE staff. First place in our tally for quality also goes to Steve Ciarcia, with Stephen Satchell receiving an additional $50 award. Congratulations to all.

COMING UP IN BYTE

Theme:
How do you make a computer blindingly fast? In terms of design, the choice has always come down to balancing the demands of silicon and software. Where do you put the simplicity? Where does the complexity go? In April's theme on instruction set strategies, we take an in-depth look at efficiency in terms of reduced instruction set computers (RISC) and their terminological offspring, CISC (complex instruction set computers) and WISC (writable instruction set computers).

Features:
Features due to appear soon include a construction piece on building a BERT (basic educational robot trainer). Another construction article being readied is one that shows you how to build an 80386 expansion board that will go into your present IBM PC and/or compatible computer.

Reviews:
We're up to our eyebrows in printers these days. Results of our testing will appear soon. As promised in our preview of the Apple IIGS, a comprehensive BYTE review is ready to roll.

Circuit Cellar:
A hardware builder's answer to the store-bought laser pistol.

Special 68000 Series:
Home-buildable projects for the Atari 520ST.

Programming Articles:
"Concurrent Programming in Turbo Pascal"; "A C Interface for ANSI.SYS."

EDITORIAL INDEX BY COMPANY

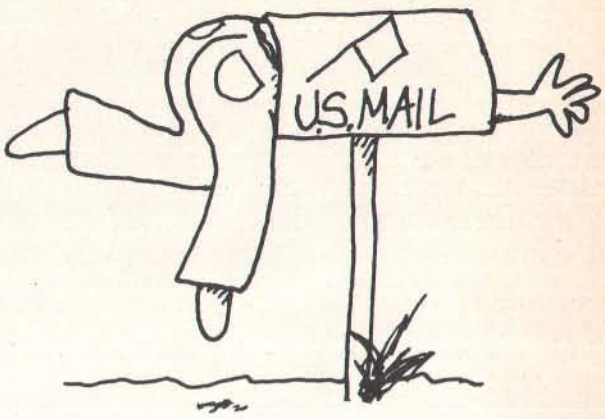
Page refers to the first page of an article or section
in which products made by the company are discussed.

COMPANY	PAGE
ABVENT	29
ADOBE SYSTEMS INC.	29
AIRUS INC.	271
ALDUS CORP.	29, 271, 291
ALTSYS CORP.	271
ANSA SOFTWARE	271
ANTIC SOFTWARE	235
APPLE COMPUTER INC.	271, 291
APPLE PROGRAMMERS AND DEVELOPERS ASSOCIATION	9
APPLIED CREATIVE TECHNOLOGY	251
ASAM GLASS	9
ASHTON-TATE	271
AT&T	215, 251
ATARI CORP.	9, 29, 251, 291
BDS CORP.	215, 251
BLYTH SOFTWARE INC.	271
BORLAND INTERNATIONAL	29, 101, 113, 271, 279
BRAINPOWER INC.	29
BRITISH TELECOM RESEARCH LABORATORIES	279
CANON USA	191, 215
CARNEGIE MELLON UNIV.	9
CE SOFTWARE	271
CHALK RIVER NATIONAL LABORATORY	9
CHORUS DATA SYSTEMS	151
COLOR SYSTEMS TECHNOLOGY	151
COLORIZATION INC.	151
COMMODORE BUSINESS MACHINES	84, 191, 291
COMPAQ COMPUTER CORP.	271
COMPUPRO	251
COMPUTER PERIPHERALS	29
CORAL SOFTWARE	9
CRAY RESEARCH INC.	143
DALLAS SEMICONDUCTOR	113
DATACOPY CORP.	197
DATAVUE TECHNICAL SYSTEMS	291
DAVLE TECH INC.	29
DIGITAL RESEARCH INC.	223
DISCOVERY SOFTWARE INTERNATIONAL	291
DUBNER COMPUTER SYSTEMS	151
ELECTRONIC ARTS	191
ESOFT SOFTWARE	29
EVEREX SYSTEMS INC.	29
EXPERTELLIGENCE	9
FIVESTAR ELECTRONICS INC.	29
FRED FISH	191
FULTON FINDINGS	29
GENERAL ELECTRIC CO.	113
GOLD HILL COMPUTERS	29, 223
GOOD SOFTWARE CORP.	29
HAND HELD PRODUCTS INC.	29
HAYES MICROCOMPUTER PRODUCTS INC.	271
HEWLETT-PACKARD	29, 251
HITACHI	279
HONEYWELL INFORMATION SYSTEMS	29
HUGHES AIRCRAFT	9
IBM CORP.	84, 101, 113, 143, 151, 191, 209, 279, 291
IMAGE PROCESSING SYSTEMS	29
INFOSCIENCE SERVICES	9
INTEL CORP.	29, 113
INTREP CORP.	29
INTRONICS COMPUTER CORP.	29
ISLAND GRAPHICS	215
J.W. HARTWELL AND ASSOCIATES	29
KAYPRO CORP.	29, 251
KOMAG	9
LATTICE INC.	129, 191
LISP MACHINE	9
LIVING VIDEOTEXT INC.	271
LOTUS DEVELOPMENT CORP.	29
MANHATTAN GRAPHICS	271
MAXI-SWITCH CO.	29
MEDIA CYBERNETICS INC.	151
MERIDIAN SOFTWARE SYSTEMS INC.	29
MICRO LOGIC CORP.	29
MICRO-ROBOTICS LTD.	279
MICROBOTICS	191, 291
MICROMINT INC.	113
MICROPRO INTERNATIONAL	9, 29, 251, 271
MICROSOFT CORP.	101, 129, 209, 251, 271
MICROSPEED INC.	29, 271
MICROSTAR LABORATORIES	29
MIX SOFTWARE INC.	29
NCR CORP.	209
NEC	251, 279
NEW HORIZON SOFTWARE	291
NEWTEK	191, 291
OCCIDENTAL COMPUTER SYSTEMS INC.	29
OFFICE AUTOMATION SYSTEMS INC.	29
OKIDATA	271
OMNITEL INC.	251
ORANGE MICRO INC.	271
ORCHID TECHNOLOGY	29
PANASONIC INDUSTRIAL CO.	191
PAPERBACK SOFTWARE INTERNATIONAL	271
PC'S LIMITED	251
PERCEPT	271
PIXAR	143
PRO CODE INTERNATIONAL INC.	223
PROMETHEUS PRODUCTS INC.	271
QIC RESEARCH INC.	209
QMS INC.	215, 271
QUADRAM	215
RADIO SHACK	251
REVOLUTION SOFTWARE INC.	271
RICOH CORP.	215
RIX SOFTWORKS	251
RON RISLEY	271
RPM SYSTEMS	29
SCOA SYSTEMS	29
SHAREDATA	9
SMETHERSBARNES	29
SOFTKLONE DISTRIBUTING CORP.	271
SOFTWARE PUBLISHING CORP.	235
SOLUTION SYSTEMS	29
SONY CORP.	113, 215, 251
SPECTRONICS CORP.	29
SPECTRUN SOFTWARE	29
STANDARD MICROSYSTEMS CORP.	29
STANFORD UNIV.	9
STEP CONTROL LTD.	29
SUMMAGRAPHICS CORP.	215
SYMBOLICS	9
SYMMETRIC COMPUTER SYSTEMS	9
SYNAPTICS INC.	9
T/MAKER	235
TALARIS SYSTEMS INC.	29
TAXAN CORP.	29
TECTRANS	29
TEMPUS DEVELOPMENT CORP.	29
TEXAS INSTRUMENTS	223
THE ASTRONOMICAL SOCIETY OF THE PACIFIC	9
TOSHIBA AMERICA INC.	29
TOUCHBASE SYSTEMS INC.	251
TRAVELING SOFTWARE	271
U.C. SAN DIEGO	9
U.S. ROBOTICS INC.	271
UNIVERSAL MACHINE INTELLIGENCE LTD.	279
UNKEL SOFTWARE INC.	29
VICTOR TECHNOLOGIES INC.	209
VIDCO	29
VIDICON	143
VM PERSONAL COMPUTING	251
WENDIN INC.	223
WESTERN AUTOMATION	291
WESTVIEW PRESS	251
WHITE CRANE SYSTEMS	29
WORDPERFECT CORP.	251
XEBEC	29
XEROX CORP.	29
XYQUEST INC.	271
ZENITH DATA SYSTEMS	251

Subscription Problems?

We want to help!

If you have a problem with your BYTE subscription, write us with the details. We'll do our best to set it right. But we ***must*** *have the name, address, and* ***zip*** *of the subscription (new and old address, if it's a change of address). If the problem involves a payment, be sure to include copies of the credit card statement, or front and back of cancelled checks. Include a "business hours" phone number if possible.*



BYTE

Subscriber Service
P.O. Box 6821
Piscataway, NJ 08854

BYTE ADVERTISING SALES STAFF:

Dennis J. Riley, Advertising Sales Manager, One Phoenix Mill Lane, Peterborough, NH 03458, tel. (603) 924-9281

NEW ENGLAND
ME, NH, VT, MA, RI,
ONTARIO, CANADA & EASTERN CANADA
Paul McPherson Jr. **(617) 262-1160**
McGraw-Hill Publications
575 Boylston Street
Boston, MA 02116

ATLANTIC
NY, NYC, CT, NJ (NORTH)
Leah G. Rabinowitz **(212) 512-2096**
McGraw-Hill Publications
1221 Avenue of the Americas—39th Floor
New York, NY 10020

Dick McGurk **(203) 968-7111**
McGraw-Hill Publications
Building A—3rd Floor
777 Long Ridge Road
Stamford, CT 06902

EAST
PA, KY, OH, NJ (SOUTH), MD, VA, W.VA, DE, D.C.
Daniel Ferro **(215) 496-3833**
McGraw-Hill Publications
Three Parkway
Philadelphia, PA 19102

NORTHEAST MAIL ORDER AND RETAIL ACCOUNTS
Bill Watson **(603) 924-7255**
One Phoenix Mill Lane
Peterborough, NH 03458

SOUTHEAST
NC, SC, GA, FL, AL, TN
(404) 252-0626
McGraw-Hill Publications
4170 Ashford-Dunwoody Road
Suite 420
Atlanta, GA 30319

MIDWEST
IL, MO, KS, IA, ND, SD, MN, WI, NB, IN, MI
Bob Denmead **(312) 751-3740**
McGraw-Hill Publications
Blair Building
645 North Michigan Ave.
Chicago, IL 60611

SOUTHWEST, ROCKY MOUNTAIN
UT, CO, WY, OK, TX, AR, MS, LA
Kevin Harold **(214) 458-2400**
McGraw-Hill Publications
Prestonwood Tower—Suite 907
5151 Beltline
Dallas, TX 75240

SOUTH PACIFIC
SOUTHERN CA, AZ, NM, LAS VEGAS
Jack Anderson **(714) 557-6292**
McGraw-Hill Publications
3001 Red Hill Ave.
Building #1—Suite 222
Costa Mesa, CA 92626

Karen Niles **(213) 480-5243, 487-1160**
McGraw-Hill Publications
3333 Wilshire Boulevard #407
Los Angeles, CA 90010

NORTH PACIFIC
HI, WA, OR, ID, MT, NORTHERN CA, NV (except LAS VEGAS), W. CANADA
Mike Kisseberth **(415) 362-4600**
McGraw-Hill Publications
425 Battery Street
San Francisco, CA 94111

Bill McAfee **(415) 349-4100**
McGraw-Hill Publications
951 Mariner's Island Blvd.—3rd Floor
San Mateo, CA 94404

WEST COAST MAIL ORDER AND RETAIL ACCOUNTS
Tom Harvey **(805) 964-8577**
3463 State Street—Suite 256
Santa Barbara, CA 93105

The Buyer's Mart
Karen Burgess **(603) 924-3754**
Mary Ann Goulding **(603) 924-9281**
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

BYTE BITS (2x3)
Dan Harper **(603) 924-6830**
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

Post Card Mailings National
Ed Ware **(603) 924-6166**
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

International Advertising Sales Staff:

Mr. Hans Csokor
Publimedia
Reisnerstrasse 61
A-1037 Vienna, Austria
222 75 76 84

Mrs. Gurit Gepner
McGraw-Hill Publishing Co.
PO Box 2156
Bat Yam, 59121 Israel
3 866 561 321 39

Mr. Fritz Krusebecker
McGraw-Hill Publishing Co.
Liebigstrasse 19
D-6000 Frankfurt/Main 1
West Germany
69 72 01 81

Mrs. Maria Sarmiento
Pedro Teixeira 8, Off. 320
Iberia Mart I
Madrid 4, Spain
1 45 52 891

Mr. Andrew Karnig
Andrew Karnig & Associates
Finnbodavagen
S-131 31 Nacka, Sweden
8-44 0005

Mr. Alain Faure
McGraw-Hill Publishing Co.
128 Faubourg Saint Honore
75008 Paris
France
(1) 42-89-03-81

Mr. Arthur Scheffer
McGraw-Hill Publishing Co.
34 Dover St.
London W1X 3RA
England 01 493 1451

Manuela Capuano
McGraw-Hill Publishing Co.
Via Flavio Baracchini 1
20123 Milan, Italy
02 86 90 617

Seavex Ltd.
400 Orchard Road, #10-01
Singapore 0923
Republic of Singapore
Tel: 734-9790
Telex: RS35539 SEAVEX

Seavex Ltd.
503 Wilson House
19-27 Wyndham St.
Central, Hong Kong
Tel: 5-260149
Telex: 60904 SEVEX HX

Hiro Morita
McGraw-Hill Publishing Co.
Overseas Corp.
Room 1528
Kasumigaseki Bldg.
3-2-5 Kasumigaseki,
Chiyoda-Ku
Tokyo 100, Japan
3 581 9811

Mr. Ernest McCrary
Empresa Internacional de Comunicacoes Ltda.
Rua da Consolacao, 222
Conjunto 103
01302 Sao Paulo, S.P., Brasil
Tel: (11) 259-3811
Telex: (100) 32122 EMBN

READER SERVICE

Inquiry No.		Page No.
346	ABSOFT	314
2	ACS IMPORTERS	371
3	ADDMASTER CORP.	372
4	ADOBE	59
5	ADTEK	296
6	ADV. INTELLIGENCE TECH.	375
348	ADVANCED COMP. PROD.	368
349	ADVANCED COMP. PROD.	368
7	ADV. DIGITAL CORP.	28
8	ADV. DIGITAL CORP.	28
9	AICON SYSTEMS	147
10	ALF PRODUCTS	369
11	ALPHA PRODUCTS CO.	350
12	ALPS AMERICA	124, 125
13	ALPS AMERICA	124, 125
14	ALSYS LTD.	257
15	AMDEK CORP.	61
16	AMER. DESIGN COMPONENTS	273
17	AMERICAN MENSA, LTD.	344
362	AMERICAN RESEARCH	258
363	AMERICAN RESEARCH	258
358	AMERICAN SEMICONDUCTOR	351
359	AMERICAN SEMICONDUCTOR	351
20	AMERICAN SMALL BUSN. COMP.	133
361	AMERICAN SOFTWARE HOUSE	295
21	AMPRO COMPUTERS INC.	54
22	AO ELECTRONICS	369
24	APPARAT	314
25	APPLIED KNOWLEDGE GRP.	270
26	APPRO-TECH INC.	374
27	APROTEK	372
28	ARITY CORPORATION	272
*	AST RESEARCH	14, 15
*	AT&T COMMUNICATIONS	347
30	AT&T PHOTO & IMAGING	316, 317
31	ATI TECHNOLOGIES	221
32	ATRON CORP.	60
33	ATRONICS	142
34	AVOCET SYSTEMS INC.	285
35	B&B ELECTRONICS	386
*	B&C MICROSYSTEMS	374
*	B&C MICROSYSTEMS	376
*	BARRINGTON SYSTEMS	25
369	BASF	300
36	BAY EXPRESS	376
37	BAY TECHNICAL ASSOC.	78
38	BIBLE RESEARCH	242
39	BIT SOFTWARE	324
41	BORLAND INT'L.	CII, 1
42	BORLAND INT'L.	CII, 1
43	BP MICROSYSTEMS	378
*	BUYER'S MART	355-362
*	BYTE BACK ISSUES	298
45	BYTE CONNECTION	374
450	BYTE INFO EXCHANGE (BIX)	354
*	BYTE MARKETING	159
*	BYTE SUB. MESSAGE	298
*	BYTE SUB. SERVICE	402
*	BYTE SUB. SERVICES	352
46	BYTEK COMPUTER CORP.	336
47	CALCOMP	107
48	CALCOMP	107
*	CALIFORNIA DIGITAL	389
49	CANETICS, INC.	372
50	CAPITAL EQUIPMENT	284
364	CARTREX CORP.	253
365	CARTREX CORP.	253
52	CENTRAL COMPUTER PRODS.	371
53	CENTROID CORP.	367
373	CHAS MICROSYSTEMS INC.	386
54	CHUNG YU	348
55	CITIZEN AMERICA	337
56	CLUB AT	241
*	CODEX CORP.	335
355	COEFFICIENT SYS. CORP.	349
58	COGITATE	372
59	COGITATE	378
63	COMPUCLASSICS	73
64	COMPUDATA TRANSLATORS	388
*	COMPUPRO	302
65	COMPUSAVE	364
66	COMPUSERVE	150
69	COMPUTER CONTINUUM	388
*	COMPUTER EDITYPE SYSTEMS	384
70	COMPUTER FRIENDS	294
174	COMPUTER LIBRARY	275
370	COMPUTER MART	386
71	COMPUTER MAIL ORDER	138, 139
*	COMPUTER MUSEUM	353
372	COMPUTER PARTS GALORE	386
72	COMPUTER SURPLUS STORE	384
73	COMPUTER WAREHOUSE	190
74	COMPUTER WAREHOUSE	190
75	COMPUTERBANC	381
76	CRAYON GRAPHICS CENTER	367
77	CUESTA SYSTEMS	106
78	CURTIS, INC.	367
79	CUSTOM SOFTWARE SYSTEMS	72
80	DAC SOFTWARE	43
82	DATA SPEC	344
83	DATA SPEC	344
84	DATA TRANSLATION INC.	315
85	DATADESK INTERNATIONAL	135
86	DATADESK INTERNATIONAL	135
93	DCS	374
87	DIGITAL PRODUCTS	193
88	DIGITALK INC.	243
89	DISK WORLD! INC.	314
90	DISKCOTECH	378
91	DISKETTE CONNECTION	369
68	DISKMASTER	382
92	DISKS PLUS INC.	331
95	DRESSELHAUS COMP. PROD.	181
96	EARTH COMPUTERS	301
97	EASTMAN KODAK CO.	269
98	ECOSOFT	323
99	ELECT. PROTECTION DEVICES	348
101	ELEXOR INC.	376
102	ELLIS COMPUTING INC.	154
301	ENGINEER'S COLLABORATIVE	388
104	EVEREX SYSTEMS	37
105	EVEREX SYSTEMS	37
106	EVSAN	386
108	FARBWARE	376
109	FILTREX RESEARCH INC.	369
110	FLAGSTAFF ENGINEERING	250
111	FLAGSTAFF ENGINEERING	250
112	FOCUS ELECTRONICS	242
113	FORTRON CORPORATION	387
114	FOX SOFTWARE INC.	22
115	G.A.S. INTERNATIONAL	177
116	GALACTICOMM INC.	184
120	GENOA	93
121	GIMPEL SOFTWARE	306
122	GLOBAL COMPUTER SUPPLIES	372
123	GOLDEN BOW SYSTEMS	384
124	GOLDEN BOW SYSTEMS	388
126	GRAFPOINT	376
127	GRAND UNION MICROSYSTEMS	372
128	GTEK INC.	24
129	H&S SALES, INC.	369
*	HARMONY COMPUTERS	62
130	HCR	334
131	HERCULES COMP. TECH.	100
132	HERCULES COMP. TECH.	100
133	HERSEY MICRO CONSULTING	136
134	HITECH INT'L INC.	252
135	HOOLEON COMPANY	346
136	HOOLEON COMPANY	346
137	HOUSTON INSTRUMENTS	63
138	HUNTER SALES	370
139	IBEX COMP. CORP.	374
140	IBM (ISG) SERVICES	50, 51
141	I.C. EXPRESS	374
142	IMPERIAL COMP. PROD.	351
328	INFOMASTER	95
143	INNER LOOP SOFTWARE	376
144	INTECTRA INC.	378
145	INTEGRAND RESEARCH CORP.	194
367	INTEL CORP.	342, 343
60	INTELLISOFT	263
146	INTERCONTINENTAL MICROSYS	159
147	IO TECH	367
148	JACO ENTERPRISES	386
149	JADE COMPUTER	392, 393
150	JAMECO ELECTRONICS	390, 391
151	JDR INSTRUMENTS	329
152	JDR MICRODEVICES	394, 395
153	JDR MICRODEVICES	396, 397
154	JDR MICRODEVICES	398, 399
155	JMR ELECTRONICS	388
157	JVB ELECTRONICS	376
158	KADAK PRODUCTS LTD.	346
347	KEA SYSTEMS LTD.	382
159	KEITHLY/DAC	232
160	LABORATORY MICROSYS.	76
161	LAHEY COMPUTER SYSTEMS	268
162	LATTICE, INC.	262
163	LAWSON LABS	381
166	LIFEBOAT ASSOCIATES	284
350	LOGICAL DEVICES	256
351	LOGICAL DEVICES	256
168	LOGICAL SYSTEMS	378
400	LOGICSOFT	48Q-V
170	LOGITECH INC.	45
171	LOGITECH INC.	47
172	LONE STAR SOFTWARE INC.	366
*	LOTUS DEVELOPMENT	80, 81
*	LOTUS DEVELOPMENT	188, 189
*	LOTUS DEVELOPMENT	246, 247
*	LOTUS DEVELOPMENT	264, 265
*	LOTUS DEVELOPMENT	332, 333
*	LOTUS METRO	166, 167
*	MACMILLAN BOOK CLUBS	288, 289
175	MAGITRONIC TECHNOLOGY	313
176	MANDRILL CORP.	378
177	MANX SOFTWARE SYS.	185
178	MANX SOFTWARE SYS.	199
179	MARK WILLIAMS CO.	35
180	MARK WILLIAMS CO.	171
181	MATHSOFT INC.	19
*	MAXELL DATA PRODUCTS	7
*	MCGRAW-HILL CEC	128A, B
*	MCGRAW-HILL NRI	320, 321
183	MEAD COMPUTER CORP.	377
156	MEGA ENGINEERING	386
184	MEGASOFT	378
185	MEGATEL	334
186	MERRITT COMP. PRODUCTS	388
187	MICRO COM SYSTEMS	132
195	MICRO DATA BASE SYS.	282
188	MICROGRAFX	23
*	MICROMINT	380
189	MICRON TECHNOLOGY	286
190	MICROPORT SYSTEMS, INC.	267
191	MICROPROCESSORS UNLTD.	388
*	MICROSOFT CORP.	53
374	MICROSOFT CORP.	200, 201
366	MICROSOFT CORP.	202, 203
368	MICROSOFT CORP.	308, 309
*	MICROSOFT CORP.	312
193	MICROWARE SYSTEMS	283
194	MICROWAY	112
196	MIX SOFTWARE	213
197	MOUNTAIN COMPUTER	79
198	MS CORP.	381
352	MULTI-TECH SYS.	325
353	MULTI-TECH SYS.	325
200	NANTUCKET	39
201	NANTUCKET	39
202	NATIONAL INSTRUMENTS	206
203	NATIONAL MEMORY SYS.	278
204	NEC HOME ELECTR.USA	161
205	NEC HOME ELECTR.USA	163
206	NEC HOME ELECTRONICS	307
207	NEC INFORMATION SYS.	CIII
208	NEW ENGLAND SOFTWARE	304
209	OLLA COMPUTER SYS.	292
211	ORCHID TECHNOLOGY	17
212	ORCHID TECHNOLOGY	17
214	ORION INSTRUMENTS	126
216	P.D. SIG	369
217	PANASONIC COMPUTER	69
218	PATHFINDER SOFTWARE INC.	330
219	PATTON & PATTON	384
220	PC AMER.MARKETING INC.	363
221	PC COMP. BROKERS	372
222	PC HORIZONS	384
61	PC INNOVATIONS	222
223	PC NETWORK	56, 57
224	PC PRO SYSTEMS, INC.	386
226	PC TECH	62
227	PC'S LIMITED	110, 111
228	PECAN SOFTWARE SYS. INC.	157
229	PERMA POWER ELECTRONICS	193
230	PERSOFT INC.	8
231	PERSONAL COMP. SUPPORT GRP.	208
232	PERSONAL TEX INC.	322
233	PETER NORTON	149
234	PINECOM COMPUTER INC.	383
235	PMI	70
236	PMI	70
*	PRENTICE-HALL BOOK CLUBS	33
237	PRINCETON GRAPHIC SYS.	40, 41

TO GET FURTHER information on the products advertised in BYTE, either pick up your touch-tone telephone and use TIPS (if you are a subscriber), or fill out the reader service card. Either way full instructions are provided following this reader service index which is provided as an additional service by the publisher, who assumes no liability for errors or omissions. *Correspond directly with company.

Inquiry No.		Page No.
165	PROGRAMMER'S PARADISE	373
238	PROGRAMMER'S SHOP	261
331	PROTEUS TECHNOLOGY CORP.	91
239	PUBLIC DOMAIN SFT. COPY	367
240	PURPLE COMPUTING	384
241	QIC RESEARCH	196
242	QSP	280
243	QUA TECH INC.	371
244	QUA TECH INC.	371
245	QUA TECH INC.	371
246	QUA TECH INC.	371
247	QUA TECH INC.	371
248	QUANTUM SOFTWARE	66
249	QUBIE'	18
250	QUELO, INC.	374
251	QUICKSOFT	123
252	QUINN-CURTIS	369
253	RA-LO INC.	330
254	RADIO SHACK	CIV
255	RAIMA CORP.	20
256	RAINBOW TECHNOLOGIES	70
257	RAINBOW TECHNOLOGIES	70
258	REAL TIME DEVICES	388
259	REVOLUTION SOFTWARE INC.	58
260	RICK'S INDUSTRIES	331
261	ROLAND CORP.	310
262	ROSE ELECTRONICS	381
263	RYAN MCFARLAND	277
264	S'NW ELECTR. & APPL.	154
265	S-100 DIV. 696 CORP.	385
266	S-100 DIV. 696 CORP.	385
267	SAFEWARE	388
268	SAMSUNG ELECTRON DEVICES	234
269	SAMSUNG ELECTRON DEVICES	234
270	SBT CORPORATION	75
271	SCIENTIFIC ENGR. LABS	384
272	SCR CORPORATION	382
273	SEAGATE TECHNOLOGY	179
274	SEAGATE TECHNOLOGY	179
275	SILICON SPECIALTIES	255
276	SILICON SPECIALTIES	255
277	SINGLE BOARD SYSTEMS	384
*	SOFT*RITE	364
278	SOFTCRAFT (TX)	21
279	SOFTCRAFT INC.	168
280	SOFTCRAFT INC.	168
281	SOFTKLONE DISTRIBUTING	157
282	SOFTLINE CORP.	77
283	SOFTLOGIC SOLUTIONS INC.	231
284	SOFTLOGIC SOLUTIONS INC.	233
285	SOFTRONICS	382
286	SOFTWARE LINK, THE	31
287	SOFTWARE LINK, THE	31
288	SOLUTION SYSTEMS	259
289	SOPHISTICATED SOFTWARE	74
290	SOURCE ELECTRONICS	68
291	SOURCE ELECTRONICS	68
292	SPECTRUM SOFTWARE	187
354	STSC INC.	338, 339
293	SUBLOGIC	175
294	SUNCOAST SYSTEMS	68
296	SYMMETRIC COMP. SYSTEMS	260
297	TANDON	305
298	TAXAN CORPORATION	245
299	TDK ELECTRONICS	297
300	TEAM TECH	254
302	TECH PC	26, 27
303	TECH PC	26, 27
305	TECHNOLAND	287
*	TELEVIDEO SYSTEMS	99
307	TEXAS INSTRUMENTS	319
308	TIGERTRONICS	384
309	TIGERTRONICS	74
310	TIME/DESIGN	183
311	TIME/DESIGN	183
*	TIMELINE	379
*	TOSHIBA AMERICA	341
*	TOSHIBA AMERICA/ISD	172, 173
356	TOUCHBASE SYSTEMS, INC.	266
357	TOUCHBASE SYSTEMS, INC.	266
*	TRANSEC SYSTEMS	259
314	TRI STATE COMPUTER	362
315	TURBOPOWER SOFTWARE	239
316	TURNPOINT AMERICA	137
317	U.S./DISK, INC.	365
318	UNIVERSAL DATA SYSTEMS	327
319	USROBOTICS, INC.	303
320	USROBOTICS, INC.	303
321	VEN-TEL CORP.	11
322	VERBATIM	345
323	VICTORY ENTERPRISES	283
118	VIDEO SHOW	214
119	VIDEO SHOW	214
324	VIDEX	281
371	VISUAL AGE	386
325	VOYETRA TECHNOLOGIES	382
326	WAREHOUSE DATA PRODUCTS	71
327	WELLS AMERICAN	13
329	WHOLESALE OUTLET	330
330	WILEY PROFESSIONAL SOFTW.	55
332	WINTEK CORP.	5
333	WINTEK CORP.	382
334	WISETEK INT'L, INC.	326
335	WOODCHUCK INDUSTRIES	367
337	WYSE TECHNOLOGY	290
338	XEMAG	382
339	XEROX CORP.	64, 65
340	Z-WORLD	198
341	ZSOFT CORPORATION	293
342	ZSOFT CORPORATION	293
343	ZSOFT CORPORATION	299
344	ZSOFT CORPORATION	299
345	ZUCKERBOARD/ATD	274

** Correspond directly with company.*

INTERNATIONAL ADVERTISING SECTION

500	AO ELECTRONICS, INC.	48N
501	ASHFORD INT'L.	48A
502	BONDWELL INT'L.	48E
*	BYTE	48M
504	CLEO SOFTWARE	48I
511	COMPUADD CORP.	48F
505	FACIT AB	48K
506	GAMMA PRODUCTIONS, INC.	48H
507	GOLDEN POWER	48L
508	GREY MATTER	48O
509	LF TECHNOLOGIES	48G
510	OREGON SOFTWARE	48C

No domestic inquiries, please.

TIPS SUBSCRIBERS ONLY!*

Use BYTE's Telephone Inquiry Processing System

Using TIPS can bring product information as much as 10 days earlier.

SEND FOR YOUR SUBSCRIBER I.D. CARD

1) If you are a new subscriber or have lost your I.D. card, circle #1 on the Reader Service Card; **attach mailer label**. We will immediately send your personal TIPS subscriber card.

GET PREPARED

2) Write your Subscriber Number, as printed on your Subscriber I.D. Card, in boxes in Step 5 below. (Do not add 0's to fill in blank boxes)

3) Write numbers for information desired in boxes in Step 7b below. (Do not add 0's to fill in blank boxes.)

CALL TIPS

4) Now, on a Touch-Tone telephone dial: **(413) 442-2668** and wait for voice commands.

ENTER YOUR SUBSCRIBER AND ISSUE NUMBERS

5) When TIPS says: "Enter Subscriber Number"
(Enter by pushing the numbers and symbols [# or * enclosed in the boxes] on telephone pad ignoring blank boxes)
Enter □□□□□□□□□#[#]

6) When TIPS says "Enter magazine code & issue code"
Enter [1][#][3][7][#][#]

ENTER YOUR INQUIRIES

7a) When TIPS says "Enter (next) Inquiry Number"
Enter one inquiry selection from below (ignore blank boxes)

b) Repeat 7a as needed (maximum 17 inquiry numbers)

1. □□□[#][#] 6. □□□[#][#] 10. □□□[#][#] 14. □□□[#][#]
2. □□□[#][#] 7. □□□[#][#] 11. □□□[#][#] 15. □□□[#][#]
3. □□□[#][#] 8. □□□[#][#] 12. □□□[#][#] 16. □□□[#][#]
4. □□□[#][#] 9. □□□[#][#] 13. □□□[#][#] 17. □□□[#][#]
5. □□□[#][#]

END SESSION

8) End session by entering [*][*][9][1][#][#]

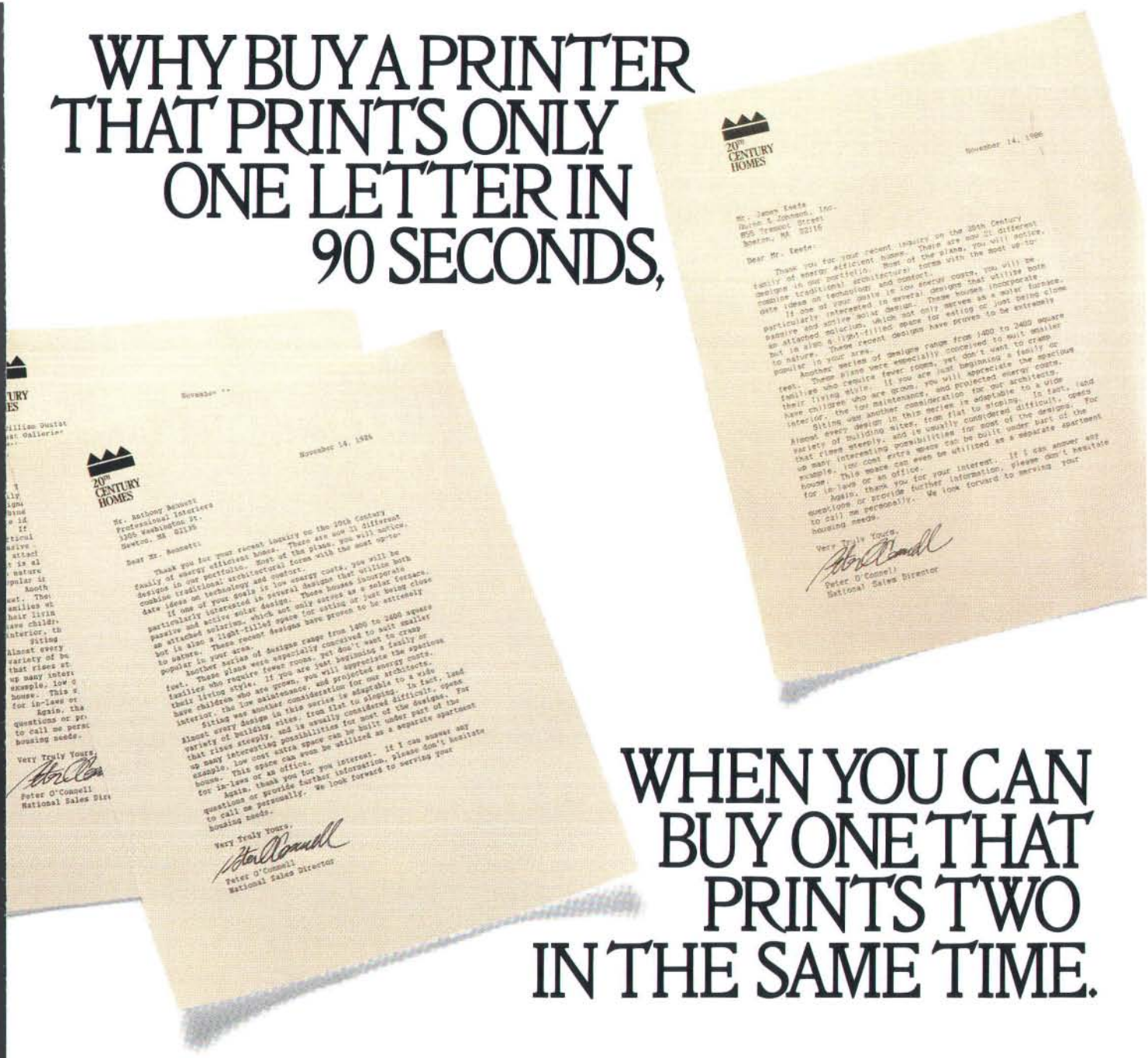
9) Hang up after hearing final message
If you are a subscriber and need assistance, call (603) 924-9281.

Available 24 Hours, 7 Days a Week

If you are not a subscriber fill out the subscription card found in this issue or, call BYTE Circulation 800-423-8912.

***Domestic and Canadian Subscribers Only!**

WHY BUY A PRINTER THAT PRINTS ONLY ONE LETTER IN 90 SECONDS,



WHEN YOU CAN BUY ONE THAT PRINTS TWO IN THE SAME TIME.

With its advanced 24-pin printhead, our Pinwriter*P6 dot matrix printer prints letter-quality characters in a single pass. Conventional 9-pin printers need two passes—and twice as much time—to do the same amount of work.

But the Pinwriter P6 isn't just faster. It's better. Because even after two passes, a 9-pin printer just can't deliver the kind of sharp, dense characters you get with our Pinwriter P6 24-pin printer. Take a look at the print sample inset above and see for yourself.

Dear Mr. Keefe,

So consider the speed. Compare the quality. Then add in the fact that NEC offers you the lowest noise level in the industry and more built-in fonts than anyone—and you'll see why our Pinwriter printers outclass every other printer in their price range.



Which is exactly what people have come to expect from NEC. After all, we're the world's largest manufacturer of 24-pin printers. And we offer more models. Some can even print three or more letters in 90 seconds.

For more information, call 1-800-343-4418 (in MA 617-264-8635). Or write: NEC Information Systems, Dept. 1610, 1414 Massachusetts Ave., Boxborough, MA 01719.

NEC PRINTERS. THEY ONLY STOP WHEN YOU WANT THEM TO.

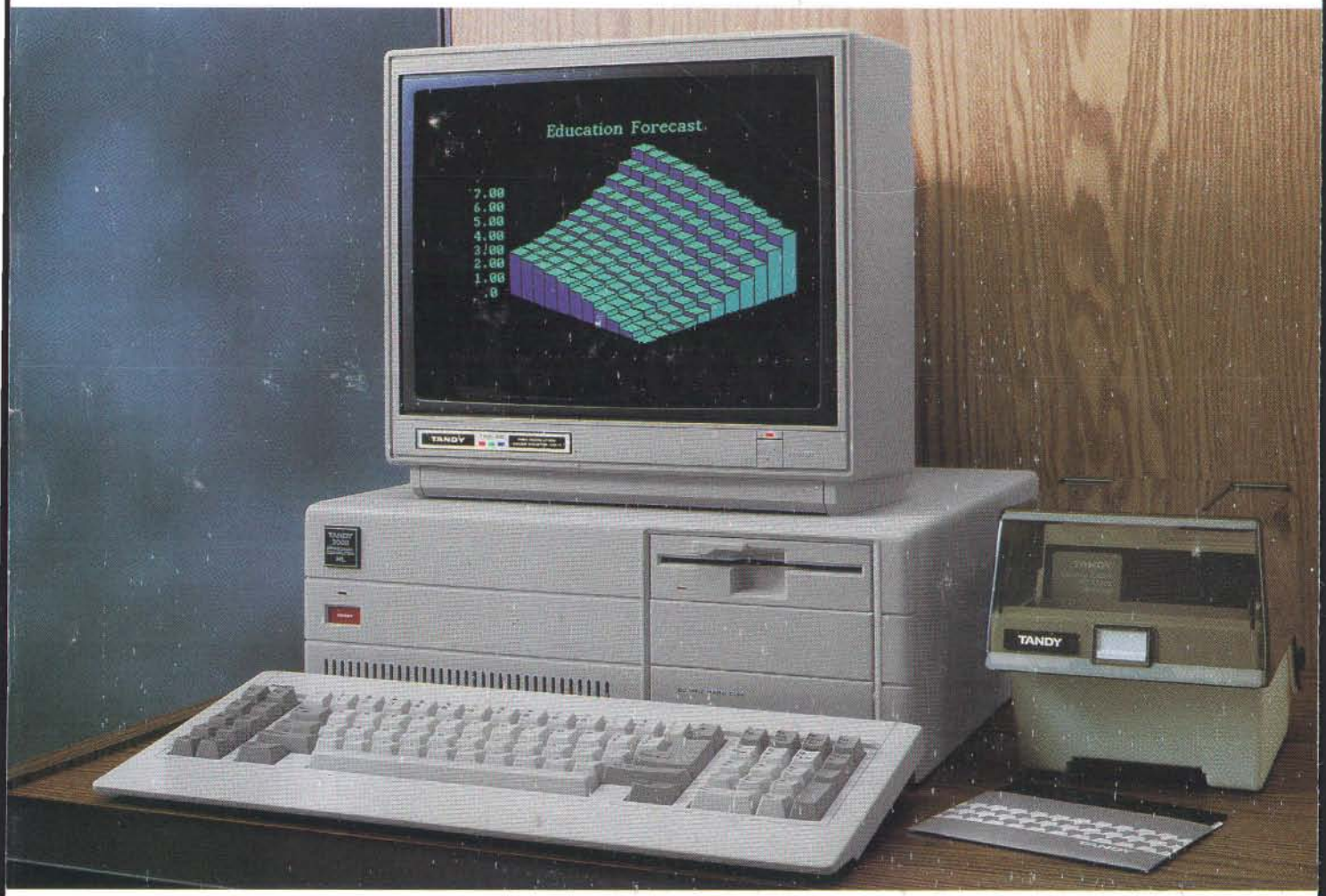
NEC

NEC Information Systems, Inc.

C&C Computers and Communications

Inquiry 207

The Tandy® 3000 HL makes 286 technology affordable.



We beat the competition...

If you're currently using MS-DOS® based computers and want to expand with more power for less, take a good look at the Tandy 3000 HL. It beats out the IBM® PC/XT-286 in price, performance and choice of options.

on performance...

Operating at 8 MHz (vs. 6 MHz for IBM's 286), the Tandy 3000 HL's advanced 16-bit microprocessor delivers up to seven times the speed of a standard PC's microprocessor. Run software faster than ever.

on flexibility...

Plus you can choose your options. Expand with more memory, hard disk drives, communications and more. Even connect the 3000 HL with other MS-DOS based computers with the ViaNet™ Local Area Network to share resources.

and on price!

The floppy-based Tandy 3000 HL starts at only $1699.

The IBM PC/XT-286 costs $3995*. True, the XT-286 comes with added features, including a 20-meg hard disk. *But a comparably equipped Tandy 3000 HL with a 20-megabyte hard disk and other options still costs less than IBM's 286.*

Come in today

Drop by a Radio Shack Computer Center and compare the Tandy 3000 HL. It delivers advanced technology for less.

Available at over 1200 Radio Shack Computer Centers and at participating Radio Shack stores and dealers.

TANDY COMPUTERS: In Business . . . for Business™

Radio Shack®
COMPUTER CENTERS
A DIVISION OF TANDY CORPORATION

*Based on IBM price list as of Sept. 2, 1986. Tandy 3000 HL price applies at Radio Shack Computer Centers and participating stores and dealers. Monitor sold separately. MS-DOS/Reg. TM Microsoft Corp. IBM/Reg. TM International Business Machines Corp. ViaNet/TM ViaNetix, Inc.

Inquiry 254